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ИНСТИТУТ МЕЖДУНАРОДНЫХ ОТНОШЕНИЙ, ИСТОРИИ И ВОСТОКОВЕДЕНИЯ
Кафедра иностранных языков для физико-математического направления и информационных технологий

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SCIENTIFIC COMMUNICATION AND SUPPLEMENTARY READING

Учебное пособие по английскому языку для магистрантов Института Физики

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Данное пособие предназначено для магистров, обучающихся по направлениям, 03.04.03 «Радиофизика» и 03.04.02 «Физика» и другим, связанным с физикой и содержит материалы, дополняющие основной курс английского языка. Пособие может быть использовано как для аудиторной работы, так и для самостоятельной работы студентов.

Предисловие

Настоящее учебное пособие предназначено для занятий с магистрантами 1-2 курсов Института Физики Казанского (Приволжского) федерального университета обучающимися по направлениям 03.04.03 «Радиофизика» и 03.04.02 «Физика». Основной целью данного пособия является повышение уровня владения профессиональным иностранным языком, достигнутого на предыдущей ступени образования, и овладение студентами необходимым уровнем коммуникативной компетенции в области профессиональной и научной деятельности, при общении с зарубежными партнерами, а также для дальнейшего самообразования.

Наряду с практической целью данный курс ставит образовательные и воспитательные цели: повышение уровня общей культуры и образования студентов, культуры мышления, общения и речи.

Задачами курса являются подготовка студентов-магистрантов к использованию английского языка как средства научно-исследовательской и профессиональной деятельности.

В задачу данного пособия входит совершенствование навыков и умений самостоятельно работать с научными текстами на английском языке с целью получения профессиональной информации, поддержания профессиональных контактов и ведения исследовательской работы.

Учебное пособие разработано с учетом требований государственного стандарта высшего образования.

При отборе текстового материала в качестве основного критерия служила информативная ценность аутентичных профессионально-ориентированных текстов и их соответствие специальности студентов. Большинство текстов пособия взято из научных журналов по профилю обучения магистров (например: International Journal of Applied Engineering Research). В отдельных случаях тексты подвергались адаптации и сокращению.

Настоящее пособие состоит из 2 частей: Scientific communication и Supplementary Reading. Первый часть включает в себя 9 тем,

соответствующих Рабочей программе обучения магистров по указанным направлениям:

Тема 1. Careers in science

Тема 2. Scientific collaboration

Тема 3. Critical thinking, reading and writing techniques.

Тема 4. Describing and discussing an experiment.

Тема 5. Presenting data of your research

Тема 6. Developing writing skills in science

Тема 7. Presenting your research

Тема 8. Socializing at a conference

Тема 9. Career development

Каждая тема включает ряд заданий, направленных на совершенствование коммуникативных навыков, связанных с научно-исследовательской и профессиональной деятельностью. Например: *Think about a research project in your area. In pairs, take turns to summarize the project following the instructions given below.*

Вторая часть включает 11 аутентичных тестов. Подготовка к чтению базового текста начинается с введения и закрепления лексики (Vocabulary). Задания к тексту направлены на то, чтобы добиться полного и точного понимания текста. Контроль понимания осуществляется через разноструктурные тестовые задания, которые способствуют усвоению и запоминанию специальных терминов в таких научных областях как физика и радиофизика. Предложенные в учебном пособии письменные задания, направлены на отработку навыков перевода и позволяют совершенствовать навыки письменной профессиональной коммуникации. Приложение включает глоссарий.

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Unit 1. SCIENTIFIC COMMUNICATION

Topic 1. Careers in science

Key skills in communication

- Planning a career in science
- Applying for research funding
- Writing up a resume or CV
- Preparing for an interview

1. In pairs, discuss the following questions.

1. Why did you choose a career in science?

2.What field of science are you currently working or studying in?

3. What would you like to do next in your work or studies?

2. Many scientists continue their education in other countries.

Make a table about higher education for science for your country and the USA, then answer the following questions.

Higher education for science in the Russian Federation

Qualification	Category	Duration	Place of study

1. Is science education in the US similar to science education in your country?

2. If you decided to study in the US, which qualification would be best for you?

3. Think about your career in science and make some notes on:

• what you enjoy most about working in your scientific field

• what you would like to do (and not like to do) next in your career

• which of your past and present experiences are most relevant to your future

in science

4. In pairs, take turns to interview your partner about his/her career path in science.

5. Read the following extract from a website and then,

in pairs, answer the questions below.

Extract from a website

The Sheridan Australian Research Fellowship (SARF) aims to develop science in Australia by attracting outstanding scientists in their field to continue their research in an Australian university or research institution. SARF fellowships are awarded to individual scientists with future potential for leadership in their field. Successful applicants receive a 5-year grant covering salary, travel and relocation costs.

Questions

1. Can an organization apply for this scholarship?
2. Would you be interested in applying for SARF? Why / why not?
3. What information might you need to include on your application form?
4. What are the advantages of attracting scientists 'with future potential for leadership in their field' to a country?

6. Think about a research project in your area. In pairs, take turns to summarize the project following the instructions (1 -6) below.

1. State the aims of your research
2. Define what the problem is
3. Explain why your topic is worth researching
4. Say what the expected outcomes of the research are
5. Outline the procedures you will follow
6. Outline how you will limit your investigation

7. Read your neighbour's completed project summary then say what you think the commercial applications of the research might be.

8. Project summary. Provide a brief summary of aims, significance and expected outcomes of the research plan

A 3-D odour-compass for odour-detecting robots

Odour-sensing robots offer many benefits over the current use of animals in similar roles, including safety, efficiency and durability. [A] **However, the robots which have been developed** to date are limited by the fact that they can only accurately detect and navigate towards odour plumes if they are within direct 'sight' of the chemical source. Clearly, in real world situations, obstacles may well impede the robot's detection ability, and at present, odour-sensing robots are therefore only of limited use. [B] **The proposed research will concentrate on developing** a robot which is able to gather readings in three dimensions and therefore overcome the limitations of current models in odour-detection. [C] **This technology will make robots a more effective substitute for animals**.

[D] **This research aims to develop** existing robotic technology to create a threedimensional (3-D) odour compass to be used as a navigation tool in searching for an odour source. [E] **This will then be tested experimentally** in simulated environments where wind direction is not stable or where obstacles interfere with odour distribution. A second stage in the research will be to develop the robot's environmental sensors, thus allowing it to safely negotiate the terrain to reach the source of the odour. [F] **This should produce a robot** which is able to both detect and move to the source of an odour, even on difficult terrain.

Match each highlighted section in the summary (A-F) to the correct function (1 -6) from the exercise 6.

9. Look at the highlighted sections A -F again. Underline the words that you could use in your own project summary.

10. Look at the list of sections in the Application form (1-10) and add to each one what information you need to provide

APPLICATION FORM

1. Applicant
2. Current appointment and address
3. Location of proposed study
4. Sponsor’s recommendation
5. Departmental support

6. Project title
7. Project summary
8. Details of proposed research
9. Budget
10. Nominated referee with personal
11. Knowledge of applicant

11. In pairs, discuss the following questions.

1. Have you ever applied for a job in science? if not, what kind of job would you like to apply for in the future?

2. Which of the following documents are job applicants usually asked for in your country?

· application form

· biodata

· cover letter (covering letter)

· resume or CV (curriculum vitae)

3. Have you ever written one of these documents in English?

4. Do you think that the information you include and the way you organise a resume or CV in English will be the same as a resume or CV in your own language?

12. Complete the following sentences.

1. My main research focus was to …

2. During my project, I focused on …

3.As part of the Cell Wall Genomics team, I have developed ….

4. I have been involved in investigating ….

13. Complete the advice for interviews using the words and phrases given below.

application form, comfortable position, facing, late, phone number, questions, see, shuffle, thank, tone of voice

Before your interview

Find out exactly who you will be talking to. Check whether they will be able to (1) _____you or just hear you. Check the date, time, the (2) _____ to dial in on, and the right code to access the conference call

Read your CV and (3)_____ again. Practise answering questions you might be asked. Prepare (4)_____ to ask the interviewer.

During your interview

- Don't be (5)_____ .
- Use your [6]_____ . to sound confident and enthusiastic
- Do not (7)_____papers (this will make a noise)
- Sit in a (8)_____- do not move about too much
- Speak very clearly, (9) _____ the microphone
- When the interview is over (10) _____ the interviewer(s) and end positively

UNIT 2

SCIENTIFIC COLLABORATION

Key skills in communication

· Communicating with scientific communities
· Writing a critical review
· Completing a Material Transfer Agreement

1. Read and remember methods of communication (1 - 6).

1.an academic journal

2. a conference

3. an online forum or science blog

4. a popular science magazine

5. a popular science book

6. a newspaper

2. Answer the following question:

Why is it important for scientists to keep in touch with:

a) other people in their field (e.g. biology)?

b) people in their specialism (e.g. molecular biology)?

c) people in other fields of science?

3. In pairs, read the following statements and say which form(s) of communication from Exercise l the speakers should use to find the

information they want.

1. I'm trying to learn more about the Hadron collider because it's big news, but it's not even close to my area so I'm finding the papers on it heavy-going.

2. A t my university, I don't meet enough people in my field - I really need to network and build some connections with people working around the world.

3. I'm having a problem with one of my protocols. I've tried a few different things, but with no luck - I could do with some suggestions from other people of wha t to try next.

4. Read the following five extracts and then say which form (or forms) of communication from Exercise 1 each one comes from. Which form(s) of communication are not included in these extracts?

1.... more people were pain-free when using the handheld device than those who had used an identical dummy device. Although the study by Lipton et at. (2010) has reliable results, there are some points to consider when putting these findings into context. Importantly, the results will need to be verified in larger trials that directly compare ...

2.Tea and coffee drinkers have a lower risk of developing type 2 diabetes, a large body of evidence shows. And the protection may not be down to caffeine since decaf coffee has the greatest effect, say researchers in Archives of Internal Medicine. They looked a t ...

3.... can be rapidly generated by lentivirus mediated transgenesis. RNAi also holds great promise as a novel therapeutic approach. This report provides an insight into the current gene silencing techniques in mammalian systems.

4.Hi! Has anyone had any experiences with nanoparticles sticking to glassware :-(? If so, does anyone know if there’s a suitable silylation protocol to pre-treat the glassware to do something about this annoying non-specific adsorption? Thanks!

5. Animal and in vitro studies suggest that aspirin may inhibit breast cancer metastasis. We studied whether aspirin use among women with breast ■ cancer decreased their risk of death from breast cancer. This was a

prospective observational study based on ...

5. How easy was it to decide where extracts came from? How did you decide on the right answer?

6. In pairs, discuss the following questions.

1. When you have a problem at work, who do you usually ask for help?

2. Have you ever asked a question on a science internet forum? If so, was your question answered?

7. Read three recent posts from an online forum (A-C) below. Imagine you belong to the forum where these questions are asked. Which questions could you answer? Which answers could you guess? Read the posts again. For each post, say which sentence or sentences (1 -3) in each one the writer uses to:

a) ask the question

b) say what the problem is

c) thank the reader

A. Subject: Filovirus Host Range?

(1) Does anybody know what the host range is for filoviruses (i.e. Ebola and Marburg)? (2) I know that they can infect most (all?) types of mammals and several species of birds, but I can't find the actual host range anywhere. (3) Any help here would be appreciated.

B. Subject: materials which x-rays can't pass through?

(D I've been looking for a while now, but I can't find anything telling me what the radiopaque materials are. (2) In other words, which materials can't x-rays pass through? (3) Thanks in advance.

C. Subject: Quality of scientific writing considered in peer review?

(1)1 was wondering how important the quality of the writing of a submitted paper is in the peer review process. (2) I don't mean the quality of the data, but the actual writing. (3) In other words, will a nicely written paper with the same data be more likely to be accepted?

8. How are the questions in the Subject field of each post different from normal questions? Think of a question related to your own research. Then write a three-sentence post for an online forum in an appropriate style using the phrases in the box to help you.

• Does anybody know what ... is ... ?

• I know that , but I can't find / don't know ...

• I was wondering how / what / why ...

• I don't mean ... , b u t ...

• In other words, ...

• Any help here would be appreciated.

• Thanks in advance.

9. In pairs, discuss the following questions.

1. What kinds of text do you need to write in English for your work or studies?

2. Why is it important to write your texts in an appropriate style?

3. What can you do to take note of the different styles of language used in English texts?

10.You have some questions about writing a critical review. In pairs, discuss questions 1 -5 . Then make notes on how your group mate answers the questions.

1.How long should my review be?

2.Can I write a critical review if I've only read the abstract?

3.How should I approach the reading? What should I read first?

4.Is it a good idea to think of questions I want answered?

5.Do I need to take notes or can I just highlight the relevant bits of the text?

11.Read the beginning of the email sent to members o f a laboratory. Then in pairs, answer the questions below.

Dear all,

Sooner or later, issues of Technology Transfer (sharing and using discoveries, inventions, materials, data etc.) will become important in your research career.

Protecting your work from competitors and, where appropriate, making it attractive to the commercial sector will be important during your career as a professional scientist. What are the key issues that you must think about?

1. What is the purpose of the email?
2. What kind of discoveries, inventions, materials and data might you share with other scientists in your field?
3. What do you think are the key issues of technology transfer?

12. Think of some material you often use in your lab. Write a brief lay summary of what the material is and what it will be used for.

In pairs, discuss the following questions.

1. Does your place of work or study have similar rules to those in the email?
2. What kind of materials require an Material Transfer Agreement?
3. What kind of information would you expect to be asked for in an MTA?

13. Complete the form (to be completed when sending or receiving material):

Material Transfer Agreement

- Recipient Researcher: _____
- Recipient Institution & Address:
- Provider Researcher: _____
- Material Name: _____
- Is this work involved with existing commercial arrangements? (1) Yes / No
- Does the work involving the material have commercial potential? (2) Yes / No
- Is this material hazardous? (3) Yes / No
- Is BioSafety Committee Approval required? (4) Yes / No
- Is Ethics Committee Approval required? (5) Yes / No
- If required, has Ethics and/or Bio Safety Approval been received? (6) Yes / No
- Who will own the IP in any modifications to, or data collected on the material? (7) University /Other/Joint

- Will any University of the South students be involved in using the material? (8) Yes / No

UNIT 3. CRITICAL THINKING, READING AND WRITING TECHNIQUES.

Key skills in communication

- reporting a scientific development
- summarizing a paragraph
- giving an evaluation

1. Read the headlines and beginnings of two news articles reporting a recent scientific development. Then answer the questions below.

"The 'Chocolate Cure For Emotional Stress". There may well be another important reason for giving your sweetheart sweets for Valentine's Day ...

"New Evidence That Dark Chocolate Helps Ease Emotional Stress"

The 'chocolate cure' for emotional stress is getting new,' support from a clinical trial published...

1. Do you think the claims made in the headlines seem likely or unlikely? Why?

2. In general, how can the science reported in the media differ from the actual science? Why do you think there is a difference?

3. If you wanted to learn more about the research you see reported in the newspaper, where could you look for more information?

2. You are a junior researcher and you are supervising a MSc Physiology student. You have asked the student to investigate the claims in the headlines and then to write a critical review of the research. Complete the sentences below in your own words. Then in pairs, discuss your answers.

a) If you read research critically, it means that you ...

b) You should always read research critically because ...

3. Your friend has some questions about writing a critical review. In pairs, discuss questions 1 -5 .

1. How long should my review be?

2. Can I write a critical review if I've only read the abstract?

3. How should I approach the reading? What should I read first?

4. Is it a good idea to think of questions I want answered?

5. Do I need to take notes or can I just highlight the relevant bits of the text?

4.Before reading, your friend writes seven questions to help him. Match the questions (1 -7) to the section of the research paper below where you would expect to find the answer.

1. What variables were investigated?

2. How did the authors interpret the results? „ . . ..

3. What were the main findings?

4. Why is this research relevant?

5. Who/What was studied?

6. What procedure was used?

7. What was the hypothesis?

A. Introduction:

B. Method :___

C. Results:____

D. Discussion: _

5. Check the meaning of the following words.

Anxiety, assessment, classify, consumption, hormone, metabolic, microbiota, participant, trial, period, urine.

6. Read two extracts from your group mate's completed critical review and answer the question.

1. Which extract (A or B) ...

a) summarizes part of the research?

b) gives an evaluation?

A. 30 young healthy adults completed a pre-trial questionnaire to assess the ir anxiety levels and based on this, they were classified as either high or low anxiety.

All participants ate 40 g of dark chocolate a day for 14 days. On days 1, 8 and 15 urine and blood samples were taken and changes in cortisol and catecholamines in the urine were analysed, as well as energy metabolism and gut microbial activity. The research found that after 14 days, the level of stress hormones in the u rine was reduced in all participants. In addition, there was less difference between the two groups in energy metabolism and gut microbial activity.

B. One problem with the research is the small sample size (only 30 people) which was further divided into smaller groups. There was also no control group in the study, making it impossible to conclude th a t chocolate was the cause of the changes seen rather than some othe r factor such as other food or drink, lifestyle change or activity level. Furthermore, only young healthy adults were investigated and so the results cannot be applied to those who are older or have pre-existing health issues.

7. Read and translate six extracts below from a critical review of another paper.

a) A bad thing about this research is there were only 20 participants. Another problem is ali the subjects were hospital employees.

b) Also, the blood flow in the brachial artery was measured before they drank the coffee, and 30 and 60 minutes after.

c) The researchers looked at how the blood flow changed.

d) The result of the research was that the people who drank caffeinated coffee had decreased blood flow to their upper arm.

e) The results might not be the same for the general population. There was also no measurement of the changes in blood pressure and blood flow after one hour, so we can't know when blood flow returns to normal.

f) 20 subjects, between the ages of 25 and 50, who usually drank little coffee, were given either a caffeinated or decaffeinated Italian espresso coffee. They gave blood before the coffee was drunk, and an hour later.

8. Put extracts a - f in the correct order to make two paragraphs. One paragraph should summarize part of the research, the other should give an evaluation.

9. Find a piece of published research you are interested in and then write two paragraphs o f a critical review in an appropriate style.

UNIT 4. DESCRIBING AND DISCUSSING AN EXPERIMENT

Key skills in communication

- describing the experiment stages
- choosing the alternative heading
- discussing the possible results

1.The scientific method is a process in which experimental observations are used to answer questions. Complete the collocations for describing the stages in the scientific method using given words and phrases.

a hypothesis - an experiment (x2) - conclusions - data (x3) - the question

1. analyse _
2. collect _
3. conduct (or run)_
4. define_____
5. design__
6. draw____
7. form ____
8. interpret _

2**. Number stages (1 - 8) in the order you would normally do them.**

Read this extract from a student website and check your answers to the exercise.

The scientific method is a process in which experimental observations are used to answer questions. Scientists use the scientific method to search for relationships

between items. That is, experiments are designed so that one variable is changed and the effects of the change observed. While the exact methodologies used vary from field to field, the overall process is the same. First, the scientist must define the question -- what exactly they are trying to find out. Next comes the formation of a hypothesis, which is an idea or explanation for a situation based on what is currently known. The next stage of the method is the design of an experiment which will allow this hypothesis to be tested. Usually a primary run of the experiment Is conducted, and any changes to the experimental setup made. In each experimental run, data collection takes place, followed by data analysis.
Finally the data is interpreted and from this, the scientist is able to draw conclusions.

3.Read the extract again to find the noun forms of the following verbs. Which word(s use(s) the same form for the verb and the noun?

Analyse, collect, design, explain, form, observe, relate, run, vary.

4. Below are the summaries of five experiments. Read each summary and then choose which word correctly completes the heading.

Practical / Theoretical research

Murray Gell-Mann and George Zweig proposed that particles such as protons and neutrons were not elementary particles, but instead were composed of combinations of quarks and antiquarks.

Field / Laboratory experiment

Mark-and-recapture models were used to measure seasonal and habitat changes in house mouse densities on sub-Antarctic Marion island.

External / Internal validity

The students were carefully matched for social status, subject area, ethnicity, education level, parental smoking, and exposure to targeted advertising

Descriptive / Experimental study

The amount of soy products eaten by each participant was assessed at the start of the study. During the 30 years of the study, the women’s incidence of breast cancer was recorded.

Qualitative / Quantitative research

To investigate the effect of eating dark chocolate on stress levels, a blood sample was taken and the levels of stress hormones measured. After eating the chocolate, a second sample was taken and hormone levels measured again.

5. In pairs, can you think of an example of an experiment which describes the alternative heading in 1 - 5 of Exercise 4 (for example, an experiment which is practical not theoretical)?

6. You are a research assistant working as part of a team investigating methods of storing hydrogen (H2) for use as an energy source. In pairs, answer the following questions.

1. What do you think are the benefits of using hydrogen as an energy source?
2. In what situations or applications could hydrogen fuels be used?

7. Hydrogen could be an ideal energy source, but is difficult to store. In pairs, look at three possible methods of hydrogen storage below and discuss what you think the advantages and disadvantages of each one might be.

a) contained as a gas in a high-pressure tank

b) condensed into a liquid and stored in a tank

c) adsorbed onto a porous material

8. Complete the following summary on variables using given below words.

Affects, collecting, controlled, data, dependent, independent.

How much a variable (1)_____ a relationship can be discovered by (2)_____ experimental ¡3)_____ on changes to the relationship as the variable Is changed.

In an experiment, there will be:

• one (A)_____ variable - this is the feature you are measuring

• one or more (5)_____ variables - these are the variables which you change

• one or more (6)_____ variables - these are not being tested and so they stay the same.

9. You want to investigate the effect of the different hydroxides (NaOH or KOH) on hydrogen adsorption in the carbon fibres.

1. In this investigation, which of the following variables will be independent and which controlled?

- carbonisation temperature
- type of hydroxide - potassium (KOH)
- heating rate or sodium (NaOH)
- nitrogen flow rate
- ratio of KOH or NaOH to carbon fibres

2. What will be the dependent variable?

10. Look at the extracts (a -f) from your group mates` discussion. Then answer the questions below.

a) May be you could look at the adsorption of hydrogen,

b) Perhaps I should look at the 1 273 K and 973 K temperatures,

c) I could make different ratios of hydroxide to carbon fibres another variable,

d) Perhaps I could start with looking just at a couple of different ratios,

e) You might be able to just look at the papers you mentioned.

f) May be I`ll have a talk to Mauritz about the adsorption protocols he's been using.

1. Do these sentences refer to the present or the future?
2. Are they used to discuss plans or suggestions?
3. What parts of speech are the underlined words?
4. What part of speech are the words in bold?

11. In pairs, role play a discussion between a researcher and a supervisor about the effect of temperature and rainfall on the population of the mosquito Aedes albopictus. First, decide which type of experiment (from Exercise 4) should be used to investigate the effects. Then discuss what the variables in the experiment might be. Use the language you studied

UNIT 5. PRESENTING DATA OF YOUR RESEARCH

Key skills in communication

- **Describing states and processes**
- **Describing data: numbers /numerical values**
- **Writing up from lab notes**

1.Match the beginnings (1 -9) to the endings (a-i) to make definitions of the words in bold.

1. A biodegradable substance is one which _____

2. A nanocapsule is a capsule which has_____

3. A removable object is one which_____

4. Endocytosis is a process by which_____

5. If a cell overexpresses a protein, it expresses_____

6. If someone is given multiple doses of a drug, they receive_____

7. Intercellular communication is communication which happens_____

8. When a drug is encapsulated, it is_____

9. If you ingest a substance, you take it_____

a) can be put in one place then taken away,

b) into your body,

c) between cetls in the same organism,

d) decays naturally,

e) put inside something else,

f) it many times,

g) molecules can move inside cells.

h) a diameter smaller than 200 x 109 meters.

i) too much of it.

2.In pairs, discuss the following questions.

1. What is nanotechnology?

2. What commercial applications could research

in nanotechnology have?

3. A teacher asked you to explain what happens during the process. Complete the following extracts from your conversation using the words in the box.

Attach, by, coat, dissolves, encapsulated, in, internalized, to, with.

1. To do this, first we _____the surface of the tube _____a chemical receptor.

2. If we want to target a tumour which overexpresses folic acid, then we _____ folate receptors_____the surface of the nanotube.

3. And then we encapsulate the d ru g _____ the tube.

4. Once the drug is _____ , we use a cap to close the open end so the drug can't escape.

5. After that, the capsule is _____ the cell.

6. I use biodegradable caps. The cap _____ and then ...

4. You are going to read eight short extracts in which scientists discuss their work. Read the questions below, check the meaning of the unknown words and choose the correct number (a, b or c).

1. What was the dosage of fluoride per kilogram of body weight?

a) 0.166 b) 0.16 c) 0.616

2) What was the sensitivity of the assay?

a) 0.02 b) 2 .0 c) 0.2

3. What is the output impedance at the 5V end?

a) 0.02 b) 0.20 c) 0.92

4. What amperage of flex is used?

a) 0.6 b) 6 c) 6.8

5. What is the temperature below which the superconductor conducts electricity with no resistance?

a) 91 b) 19 c) 90

6. What is the enthalpy change when 2 moles of water are formed at a pressure of one atmosphere and a temperature of 298 kelvin?

a) - 51 7.6 b) -5 7 1 6 c) -5 7 1 .6

7. What is the lowest frequency at which young mice squeak (make a noise) when isolated from their mother?

a) 450 b) 45 c) 405

8. What speed laser pulses were used?

a) 1 5 b) 50 c) - 50

5. In pairs, answer the following questions.

1. How do we say these values?

a) % b) 5/a c) % d) 107 e)10~9

2. How do we say these symbols?

a) % b) x (in e.g. 5 x 109) c) -

3. What is the difference between 1.356 and 1,356? How do we say them?

6. Read the information. Translate it.

The International System of Units (SI) is the most common measurement system around the world, particularly in the fields of science, commerce and trade. It is a modern form of the metric system and as such is devised around the number 10. The system consists of 7 base units and a set of prefixes. There system are a number of other common Sl-derived units.

7. In pairs, discuss the following questions.

1 What units of measurement do you commonly use in your everyday life?

2 What units do you use in your work?

3 Which SI prefixes do you know? How do they change the quantity?

8. In pairs, discuss the following questions.

1. How is the information in the results section of a paper different from the discussion section?

2. Why do researchers usually keep the results and discussion sections separate?

3. Why might some researchers present the results and discussion together as one section?

4. Some papers include a conclusion section. What is the difference between a

discussion and a conclusion?

9.Read three extracts from a research paper. Then match an extract (A-C) with the part of the paper it comes from:

the materials and methods section, the results section or the discussion section.

A.The majority of the activated carbons examined have surface are as ranging between 9 0 0 a n d 2 0 0 0 mK/g, a n d the ratio of micropore volume to total pore volume ranges between 0 .2 6 an d 0 .6 5 .

B. The highest storage factor attained is 89 for compacted grain-based activated carbons from rain sorghum. Therefore, sorghum-based activated carbons will be effective for natural gas storage in the fuel tanks of moto vehicles.

C.Carbonisation and activation were performed in an electrical-resistance furnace under a steady flow of gaseous Ns. The samples were contained in cylindrical baskets made from 60 mesh stainless steel gauze.

10. Below are two extracts from the final draft of your friend's materials and methods section, based on the lab notes for the next experiment. Complete each extract using the words in the boxes.

A

Actual, aid, and, approximately, average, due, estimated, evaporated, length, placed, ranged, suspended, to.

The experiment investigated filling carbon nanotubes with a suspension containing fluorescent beads. The tubes (1)_____in (2) ---------- from 20 (3)_____SO |jm and had an (4)_____diameter of (5)_____ 500 nm and a wall thickness of 15 nm. The tube diameters were (6) 300 (7) _ _ from electron microscope images and ranged between . 700 nm. The (8)_____tube diameters may have been smaller (9) to tube deformation. The CNTs were then (10)_____ solution and (11) on glass cover slips with the (12)_____ of dielectrophoresis. The 2-propanol then (1 3)_____ .

UNIT 6. DEVELOPING WRITING SKILLS IN SCIENCE

Key skills in communication

- Writing the introduction
- Writing the abstract
- Giving a title to your paper

1.Match the beginnings to the endings of the questions.

1.What was I…

2.Why was it…

3.What was already…

4.What did I…

5.How did I …

a)… approach the problem?

b)…already important?

c) …expect to know after doing the research?

d) … investigating?

e)…known about the subject of my research?

2.Read five extracts from the introduction to the paper. Which question from Exercise 1 is each extract answering? Write the questions above the extracts.

1. _____

Such an extreme environment was thought to be uninhabitable, but micfobial ecology studies reported the presence of microorganisms (Amaral-Zettler et al., 2002). Could the surface composition of Mars protect life against radiation?

2. _____

A number of studies have investigated different extreme Martian surface conditions on terrestrial microorganisms. Nicholson and Schuerger (2005) reported that the spores of Bacillus subtilis were able to survive for 19 days under Mars atmospheric pressure and composition. Saffary et al. (2002), however, found that survival decreased due to ...

3._____

Potential habitability in the subsurface would increase if the overlaying material did play a protective role.

4._____

For many years now, scientists have speculated about the possibility of life on Mars (Klein et al., 1976; McKay, 1997). The discovery of liquid water on Mars would increase its habitability ...

5._____

We report here on our studies of protection by Rio Tinto Basin iron oxides and hydroxides on two microorganisms, Acidithiobacillus ferrooxidans and Deinococcus radiodurans, under simulated Mars surface conditions.

3.In pairs, discuss the following questions.

1. What is the purpose of an abstract?
2. How can an abstract help a researcher choose which papers to read?
3. What Information does the abstract usually include?
4. Why do some people think a good abstract is even more important In the internet age than it was before?

4. An abstract usually contains one or two key sentences from each section of a paper. Read the following extracts from the abstract. Match a section (1 -4) to an extract (A-D).

1. Introduction_____ 3. Results_____

2. Method_____ 4. Discussion_____

A

With the aim of evaluating this possibility two microorganisms, Additbiobacillus fetrooxidans, an acidophile, and Deinococcus radiodurans, a radiation-resistant microorganism, were exposed to simulated Mars conditions; that is, 95% CO,, 2.7% N, 1.6% Ar and 0.6% H ,0 with a pressure of 7 mbars. Temperature was set at 150 K and ultraviolet radiation was in the wavelength range of 200-400 nmat. Exposure was for different times under the protection of 2 and 5 mm layers of oxidised iron minerals. Survival was evaluated by growing the organisms on fresh media.

B

The resistance of organisms to extreme conditions like the conditions which exist on the surface of Mars under the protection of a thin material layer increases the possibility that life could exist on Mars.

C

Here we report that both the 2 and 5 mm thick layers provided enough protection against radiation and Mars environmental conditions for the bacteria to survive (Figs. 2 & 3).

D

Current surface conditions on Mars are extremely challenging for life. However, Nicholson and Schuerger (2005) reported that Bacillus subtihs was able to survive for 19 days under Mars atmospheric pressure and composition. The question is whether there are any features on Mars that could provide protection against the surface conditions. One possibility is that the surface material plays a protective role due to the fact that it is composed of iron oxides and hydroxides.

5.Read the titles of six research papers. In pairs, decide which titles you think are most helpful for the reader.

- Staphylococcus aureus Host Cell Invasion
- Increase in fruit size of a spontaneous mutant of 'Gala' apple (Malus x domestica Borkh.) is facilitated by altered cell production and enhanced cell size
- Large colonial organisms many years ago
- Does warming alter the metabolic balance of ecosystems?
- Cat nap: A study of Mammalian Sleep Dynamics
- Genetic Signatures of Exceptional Longevity in Humans

6.Read seven suggestions for writing the title of a research paper. Which suggestions should you use to write a good title? Which suggestions don't give good advice?

a) Make it about 50 words long

b) Write it as a question

c) Begin with a phrase like A study o f o r An Investigation into ...'

d) Include a joke or play on words

e) Include important key words for internet search tools

f) Include information such as the species studied, the treatment used, etc.

g) Present the key result

7. Your friend is deciding on a title for his paper and has written four alternatives. In pairs, decide which title you think is best.

1. Is there life on Mars?

2. Are there any features on Mars that could provide protection against the harsh surface conditions?

3 .An investigation into whether Mars's surface material could provide protection for organisms

4. Protection for Acidithiobacillus ferrooxidans and Deinococcus radiodurans exposed to simulated Mars environmental conditions by surface material Unit

8. You use the order of your visual data to organize the text of the results section. Put the words in brackets in the correct order to complete the extracts from the results (1 -4).

1. (shown / as / Fig. 1 a / in), for a pure monolayer of graphene, the Fermi level is located about 0.42 eV above the Dirac point.

2. (shows / as / Fig. 1 d), when a 0.8 nm-thick layer of molecules was deposited, charge neutrality was reached.

3. (be / in / Fig. 3d / observed / it / that / can) as the temperature increased above 75 °C, the difference between the Dirac energy and the Fermi energy also increased.

4. (that / Fig. 3d / shows) the difference returned to the level of a pure graphene layer at 230 °C.

9. Your friend wants to compare and contrast the doping effects of TCNQ and F4-TCNQ. Read the following draft paragraph and underline the phrases

he uses to describe a comparison or a contrast.

In contrast to F4-TCNQ, the nonfluorinated version,TCNQ, showed a far less effective charge transfer, even though the fluorine atoms are not directly involved in the charge-transfer process. In the case of T C N Q , the electron affinity was 2.8 eV compared to 5.24 eV for F4-TCNQ.While charge neutrality was reached for F4-TCNQ, with TC N Q the Fermi energy remained at least 0.25 eV above the Dirac point, as shown in Fig. 4.The maximum shift o f the band structure was obtained for a T C N Q coverage of 0.4 nm (see Fig. 4d), half that of F4-TCNQ, and no additional shift was observed for higher amounts of deposited molecules.

10.The phrases in bold describe the results o f a number of other experiments. Match the beginnings (1 - 8) to the endings (a-h) to complete extracts from eight different research papers.

1. At high temperature and high pressure, a olivine **showed a noticeable**
2. The carbon nanotubes **had an extremely**
3. For the hydroxide-to-fibre ratio of 4:1, I c **slight**
4 .TAGH **had only a minor**
5. The anxiety-related metabolic differences observed in urine **were significantly**
6. **There were only marginal**
7. The robot demonstrated looping behaviour that was similar to that of the real moth and **was also highly**
8. When running horizontally on the high- h friction surface T. mauritanica's average speed **was considerably**

a) **differences were seen between** the activation efficiency of NaOH and KOH.
b) differences in the pH and temperature over the 3-month **period**,
c) **effect on DNA** synthesis and did not interact with the EGF receptor,
d) **high** capacity.

e) **reduced** following 1 and 2 weeks of dark chocolate consumption,

f) **slower than** C. draconoides.

g) **drop in** strength.

h) **successful at** locating the odour source.

11.Look at the phrases above and find adjectives and adverbs which express:

a) a large degree

b) a small degree

12.Complete the paragraphs from the results section of a paper using given words and phrases in the box.

As can be seen, in considerably contrast to, noticeably thicker, resulted in, a longer, while.

During the rapid heating, the Ni near the Ni/SiC interface reacted with the SiC, which resulted in carbon atoms moving into the Ni. The carbon atoms then separated onto the surface of the Ni during the cooling procedure, forming graphene layers (1)_____Fig. 1 b. In (2 j_____the graphene generated using single-crystalline SiC, the graphene synthesised by this process is (3)_____ easier to remove from the SiC surface.

A slower heating rate (4)_____ process. As shown in Fig. 4, more carbon atoms were released into the Ni in a long process. Higher carbon concentration in the Ni produced a (5)_____ carbon nanofilm on the Ni surface, (6)_____a lower carbon concentration reduced the thickness of the carbon nanofilm and formed graphene.

UNIT 7. PRESENTING YOUR RESEARCH

Key skills in communication

- Giving a paper at a conference

- Socialising at a conference
- Presenting a poster

1.In pairs, answer the following questions.

1. Have you ever presented your research to your team or study group? How did you prepare?

2. Have you ever given a paper to a large audience at a conference?

3. Why might presenting your research at an international conference be more difficult than presenting to your team or study group?

2.Complete the spaces with the words in the box. Then check your answers.

About, based, face, forward, giving, go, honest, how, looking, sessions, this, turnout.

1.(1)_____ was it?

Well, to be (2)_____it was a bit too clinical for me.

2.And (3)_____is Freda Watson.

3.So where are you (4)_____, Freda?

What are you (5)_____at?

4.So are you (6)_____a paper here, Magareta?

5.Well, how (7)_____you come out with us tonight?

6.So, how did the talk (8)_____?

Did you get a good (9)_____?

7.So which other (10)_____have you been to today, Milan?

8.It's good to finally meet you, Jacob, and put a (11)_____ to the name. This might seem a little (12)_____, but I wondered what opportunities there were in your lab for post-doctoral positions.

3.Complete the following words and phrases from the poster using the words in the box.

Basis, course, deadline, keynote, preliminary, presentation, registration (x2),strictly, submit, updates.

1. application_____
2. on a _____first-come, first-served_____
3. _____speakers
4. online_____only
5. poster_____
6. _____programme
7. _____ fees
8. to _____an abstract
9. in due _____
10. check back for_____

4.Match the words and phrases (1 -1 0) in Exercise 3 to the definitions (a-j).

a) research summarized in a visual display_____

b) an early plan for the conference (some details may change later)_____

c) look for further information_____

d) money you must pay to attend the conference_____

e) soon _____

f) the Internet must be used to send personal information for the conference

g) the last date that personal information can be sent to the conference organisers_____

h) the most important presenters at the conference_____

i) the organisers will only accept applications in the order they receive them

j) to send a written summary of your research because you want to present a paper_____

5.In pairs, look at the list of typical conference activities

(a-h) below and then discuss the following questions.

1. Which of these activities have you done (or might you expect to do) at conferences?

2. Which activities are easier / more difficult for you? Why?

3. Do you know any words or phrases which are appropriate for these activities?

a) making arrangements for coffee, lunch or an evening out

b) asking someone which talks they have been to

c) asking someone for their opinion on a talk

d) finding out about where someone works and what research they are doing

e) asking someone if they are giving a talk

f) asking someone how successful their presentation was

g) introducing yourself or someone else for the first time

h) networking (making useful contacts)

6. In pairs, answer the following questions.

1. Have you ever attended a conference poster presentation session? If so, did you speak with any presenters?

2. Have you ever prepared and presented a poster at a conference? If so, did anyone ask you questions about your research?

3. What do you think the key features of a good poster are?

Make a list.

7. Complete the advice below about preparing a poster using the words given below.

Abstract – colours – columns- contact- font- heading- number- sentences- simple- text- title- white space.

General points

• Give your poster a (1)_____which summarises the main idea.

• Keep your poster focused and (2) _____ so someone can understand the key points without any extra explanation.

• Remember that a poster is a summary of your work - so it's not usually necessary to include an (3)_____ .

• Don't forget to include your name and (4)_____ information.

The look of your poster

• Arrange information in (5)_____ .

• Use charts and diagrams as much as possible, only using (6)_____

to support your visuals.

• Give each section of your poster a clear (7) . _____ in large type.

• (8)_____ each section to guide readers through your poster.

• Leave plenty of (9)_____ around each section to make them stand out more easily.

The text in your poster

• Use phrases rather than full (10)_____ .

• Try to keep phrases short.

• Choose a (11)_____ size which makes the text easy to read from a distance of 1-2 metres.

• Use different (12)_____ for different kinds of information in the poster - but remember to use them consistently.

8.Find two examples of conference posters and decide how well they have been designed. Do not try to read the text on the posters, but look at each one for just five seconds and think about how it looks.

Then in pairs, answer questions 1 -3 on your first impressions.

1. Were the posters well organized?

2. Was there space around the sections?

3. Could you see the title and section headings easily?

Which poster do you think was more successful? Why?

9.Plan the design o f a poster to present a piece of your recent work.

10. Using the poster plan you created, plan a two-minute explanation of your research.

11. Present your explanation to a partner along with your poster plan. When you are listening, try to ask one or two questions at the end. When you are presenting, answer your partner's questions. Be sure to check that you have really answered their question at the end.

UNIT 8. SOCIALISING AT A CONFERENCE

1.In pairs, discuss the following questions.

1. Have you ever been to a conference? Tell your partner about your experience.

2. Do you plan to attend any conferences in the near future?

3. What might be difficult (apart from giving a presentation) about attending a conference where the main (or only) language is English?

2. In pairs, look at the list of typical conference activities (a-h) below and then discuss the following questions.

1. Which of these activities have you done (or might you expect to do) at conferences?

2. Which activities are easier / more difficult for you? Why?

3. Do you know any words or phrases which are appropriate for these activities?

a) making arrangements for coffee, lunch or an evening out

b) asking someone which talks they have been to

c) asking someone for their opinion on a talk

d) finding out about where someone works and what research they are doing

e) asking someone if they are giving a talk

f) asking someone how successful their presentation was

g) introducing yourself or someone else for the first time

h) networking (making useful contacts)

3. In pairs, role play some o f the conference activities (a-h) in Exercise 2.

4. Look at the online poster advertising a conference and answer the following questions.

1. Who might be interested in attending this conference?

2. If a researcher applies on 7 May, could he/she give a paper at this conference?

3. If you were interested in this conference, how could you find out more?

5.Think about an experiment you have been working on or that you are

familiar with. Use the topic sentences to write at least one paragraph for the results section of a paper.

6. You are asked for advice on writing up the discussion section of someone's paper. Look at some of the questions. Can you answer any of them?

1. Should I work through my discussion in the same order I used for the results?
2. Can I mention any new results?
3. Do I need to mention the results again?
4. Can I refer to other work that's been done in the area?
5. In terms of language, is there anything in particular I should be careful with?

7. Your group mate advises you to use noun phrases. Noun phrases can be used to summarize a lot of information efficiently. Read a paragraph from an early draft of your paper. Then complete the sentence from a later draft using the words and phrases given below.

deposition of electron- transfer- from movement of- towards

The Fermi level moves towards the Dirac point. When this happens, it indicates that F4-TCNQ has been deposited. When the F4-TCNQ has been deposited, the electrons are activated. When the electrons are activated, they are transferred from graphene towards the molecule.

The (1)_____ the Fermi level (2) the the Dirac point indicates that (3)_____ F4-TCNQ activates (4)_____ (5)_____ grapheme towards the molecule.

8. Complete the following sentences from three more research papers. In each space, write the noun form of the word in brackets or use of, on or to.

1. The_____ (able)_____ a gecko_____ . walls walk_____ demonstrates th a t. (activate)_____the adhesive system improves the gecko's movement over smooth surfaces.

2.The_____ (form)_____ a CaP layer_____

the surface allowed further crystal growth.

3.Although the species M. fortunata has a lower_____ (expose) to vent fluids it seems to have a higher_____ (accumulate)_____metals in its tissues.

9. In pairs, read another extract from your friend`s paper. Then combine the second and third sentences of the extract into one sentence in two different ways using:

a) a relative pronoun [which, that, who, etc.)

b) a verb

The F4-TCNQ layer is stable in air, but appears to be temperature sensitive. At temperatures above 75 °C the energy difference increases. This increase indicates that molecular desorption occurs.

Тема 9. CAREER DEVELOPMENT

1. Answer the questions

1. What can you tell about your career in science?
2. How do you prepare for your future profession?
3. How does university education help you to become a qualified specialist?
4. What do your scientific researches include?
5. Who are the most famous scientists in physics?
6. What do you know about scientific and business ethics?
7. What are the rules of scientific communication?
8. What scientific works help you in your scientific researches?
9. How to think as a scientist?
10. What are peculiarities of a scientific style of writing?

2. Discuss with the partner the following:

a) a laboratory experiment you took part in

b) scientific resources do you use in your researches

c) goals and objectives of your scientific research

d) scientific research methods you use in your researches

3. Physics is a developing branch of science, isn`t it? Prove it.

4.Complete the project summary by another researcher below using the following correct word or phrase.

aims to - however - the initial phase- the proposed research -the study will indicate

Consumer interest in wines produced in organic vineyards has increased significantly in the last few years. (1)_____ to date it is unclear whether these production methods actually improve soil or grape quality. (2)_____ will be the first phase of a long-term study on a New Zealand vineyard. These results (3)_____ whether methods of viticulture improve grape quality.

The research (4)_____ investigate the effects of organic agriculture on soil and grape quality. (5)_____ will consist of two treatments, organic and conventional (the control), each replicated four times in a randomised, complete block design. All organic practices will follow the standards set out by the Food Standards Australia New Zealand (FSANZ).

(6) _____ will assess soil quality using physical, chemical and biological indicators over six years. The next phase will then assess the physiology of the vines.

4.Write a short project summary of about 150 words for the research you discussed above.

5. Some phrases given below are appropriate when giving a formal talk on your research. Some are not. Define them. Read extracts.

1. Good afternoon, everybody. / Welcome, ladies and gentlemen...

2. To start, thank you / I'd like to start by thanking you all for coming to my talk today.

3. I'm Mike Downi and at present / My name is Mike Down and I’m a PhD candidate at Northumbria University.

4 .I'm going to talk today / My talk today is about my recent research investigating ...

5. I ’ll begin by explaining / To start with, I ’ll explain briefly how T-cell responses

6. After that, I’ll I I'll go on to describe the alternative method I have been investigating...

7. Finally, I will discuss I I ’ll conclude by discussing why this method could be useful as a way ...

8. I plan to talk for about 4 0 minutes, leaving plenty of time for 11 will talk for about 4 0 minutes and then I ’ll answer any questions at the end of my talk.

6.Match each pair o f phrases (1 -8) to their correct function (a -f) below. Note that one of the functions may be expressed with three different pairs of phrases.

a) Give instructions for asking questions._____

b) Greet the audience._____

c) Introduce the topic of the presentation._____

d) Introduce yourself._____

e) Outline the structure of the presentation._____

f) Thank the audience for coming._____

7. In pairs, discuss the following questions.

1. Have you ever applied for a job in science? if not, what kind of job would you like to apply for in the future?

2. Which of the following documents are job applicants usually asked for in your country?

• application form

• biodata

• cover letter (covering letter)

• resume or CV (curriculum vitae)

3. Have you ever written one of these documents in English?

4. Do you think that the information you include and the way you organise a resume or CV in English will be the same as a resume or CV in your own language?

8. Section 1 of the SARF application form asks applicants to include a copy

of their CV. In pairs, look at the list of possible headings for a CV (a-l) and then answer the following questions.

1. Would you use all the headings (a-l) on your CV? Why / why not?

2. How would you organise the information in your CV? Put the list of headings (a-l) in the best order.

3. What kind of information would you include under each heading? Make suggestions for each heading.

a) computer skills

b) dissertations

c) education

d) grants and awards

e) personal information

f)presentations

h)research experience

i) study abroad

j)teaching experience

k) technical skills

1)travel

9. Rewrite and translate the following sentences as bullet points.

1. My main research focus was to generate specific carbohydrate oligomers by using pure cloned enzymes.

2. During my project, I focused on the creation of a new CD4 positive HeLa cell clone.

3. As part of the Cell Wall Genomics team, I have developed sensitive methods to determine the fine structure of pectins in maize.

10.In pairs, answer the following questions.

1. What is the correct order of information in a citation?

2. If the paper has not yet been published, what do you write instead of the volume and page?

3. If the paper has been submitted (given) to a journal but not yet accepted, what do you write instead of the journal name, volume and page1

11.Rewrite the following extracts from three different papers using either a relative pronoun (which, that, who, etc.) or a verb with -ing.

1. The adhesive apparatus is only activated on sloped surfaces, not on flat surfaces even when slippage occurs. This results in greatly reduced sprinting velocity on smooth, flat surfaces.

2. Consumption of dark chocolate resulted in the decrease in the stress hormone cortisol in the urine. This suggests potential benefits of dark chocolate consumption.

3. On exposure to metals, B. azoricus demonstrates considerable antioxidant enzymatic activity. This reflects a physiological adaptation to continuous metal exposure.

12.Look at the paragraph(s).Write a paragraph for a discussion section. The discussion section of a paper often describes limitations of the current research and what experiments could be done in future. Read the following statements about someone`s research and decide whether they describe a limitation (L) or an idea for future research (F).

1. The process of charge transfer has not been investigated_____

2 .Desorption might occur because of the temperature used or because of the vacuum._____

3 .Try using higher temperatures at atmospheric pressure to see what happens._____

4 .Try doping with other TCNQ-related molecules.____

5 .The graphene sample thickness is not consistent._____

6 .F4-TCNG might be useful in silicon-based as well as graphene-based electronics_____

7. Investigate different ways of applying the F4-TCNQ la y e r_____

13.Look at the phrases below. Which can be used to express limitations and which suggestions for future research?

1. The scope of this study did not permit us to examine ...

2. Given this limitation, we do not know if/whether...

3.It is hoped that this research can serve as a basis for future studies into ...

4.This is a clear limitation of the study and raises further questions related to ...

5. These results are preliminary findings and suggest that further research on ...

14. The paragraph below describes the limitations and suggestions for future direction of a study looking at the production of grapheme layers. Complete the paragraph using the words and phrases given below.

clear -given -hoped -indicates -permit -raises –scope- serve- as

The study (1)_____ that it is possible to produce large-area graphene films using a solid-phase-based method. It is (2)_____that this research can (3}_____a basis for further studies into graphene synthesis. One limitation of the present research is that the (4)_____ of the study did not (5)_____ us to investigate the differences between using 6H-SiC and 3C-SiC/Si substrates. (6)_____ this limitation, we do not know if this method is selective for the type of SiC substrate. In addition, the current study did not investigate a range of heating rates. It is possible that lower temperatures could be used if the process were lengthened. This is a (7)_____limitation of the study and (8)_____ further research

questions related to the possibility of optimising processing conditions to better control graphene production.

Unit II. SUPPLEMENTARY READING

Text 1. SCIENTISTS MAKE MICROSCOPES FROM DROPLETS

VOCABULARY

1. emulsion [ɪ´mʌlʃn] эмульсия

2. curvature [´kə:vətʃə] кривизна

3. surfactant [sə´fakt(ə)nt] поверхностно-активное вещество

4. interfacial tension [ıntə´feıʃ(ə)l ´tɛnʃ(ə)n] межфазное натяжение

5. interface [´ıntəfeıs] граница раздела сред

6. geometry [dʒı´ɒmıtri] форма

7. application [aplı´keıʃ(ə)n] практическое применение, приложение

8. imaging capacity [ı´mıdʒıŋ kə´pasıti] разрешающая способность

9. graduate student [´grædʒuət ´stju:d(ə)nt] аспирант

10. former postdoc [´fɔ:mə pəʊs(t) ´dɒk] ученый, завершивший постдокторантуру – исследование, выполняемое после получения степени PhD

11. junior [´dʒu:nıə] студент младшего или предпоследнего курса

12. research affiliate [rı´sɜ:rtʃ ə´fılıeıt] ученый, проводящий исследования на базе исследовательского института, но в этом институте не работающий.

13. refractive index [rı´fræktıv ´ındeks] показатель преломления

14. suspended [sə´spendıd] взвешенный, смешанный до состояния суспензии

15. vial [´vaıəl] пробирка

TEXT

Read the text and translate it into Russian.

1. Liquid droplets are natural magnifiers. Look inside a single drop of water, and you are likely to see a reflection of the world around you, close up and distended as you'd see in a crystal ball. Researchers at MIT have now devised tiny "microlenses" from complex liquid droplets comparable in size to the width of a human hair. They report the advance this week in the journal Nature Communications.

2. Each droplet consists of an emulsion, or combination of two liquids, one encapsulated in the other, similar to a bead of oil within a drop of water. Even in their simple form, these droplets can magnify and produce images of surrounding objects. But now the researchers can also reconfigure the properties of each droplet to adjust the way they filter and scatter light, similar to adjusting the focus on a

microscope. The scientists used a combination of chemistry and light to precisely shape the curvature of the interface between the internal bead and the surrounding droplet. This interface acts as a kind of internal lens, comparable to the compounded lens elements in microscopes.

3. "We have shown fluids are very versatile optically," says Mathias Kolle, the Brit and Alex d'Arbeloff Career Development Assistant Professor in MIT's Department of Mechanical Engineering. "We can create complex geometries that form lenses, and these lenses can be tuned optically. When you have a tunable microlens, you can dream up all sorts of applications." For instance, Kolle says, tunable microlenses might be used as liquid pixels in a three-dimensional display, directing light to precisely determined angles and projecting images that change depending on the angle from which they are observed. He also envisions pocket-sized microscopes that could take a sample of blood and pass it over an array of tiny droplets. The droplets would capture images from varying perspectives that could be used to recover a three-dimensional image of individual blood cells. "We hope that we can use the imaging capacity of lenses on the microscale combined with the dynamically adjustable optical characteristics of complex fluid-based microlenses to do imaging in a way people have not done yet," Kolle says.

Kolle's MIT co-authors are graduate student and lead author Sara Nagelberg, former postdoc Lauren Zarzar, junior Natalie Nicolas, former postdoc Julia Kalow, research affiliate Vishnu Sresht, professor of chemical engineering Daniel Blankschtein, professor of mechanical engineering George Barbastathis, and John D. MacArthur Professor of Chemistry Timothy Swager. Moritz Kreysing and Kaushikaram Subramanian of the Max Planck Institute of Molecular Cell Biology and Genetics are also co-authors.

Shaping a curve

The group's work builds on research by Swager's team, which in 2015 reported a new way to make and reconfigure complex emulsions. In particular, the team developed a simple technique to make and control the size and configuration of double emulsions, such as water that was suspended in oil, then suspended again in

water. Kolle and his colleagues used the same techniques to make their liquid lenses. They first chose two transparent fluids, one with a higher refractive index (a property that relates to the speed at which light travels through a medium), and the other with a lower refractive index. The contrast between the two refractive indices can contribute to a droplet's focusing power. The researchers poured the fluids into a vial, heated them to a temperature at which the fluids would mix, then added a water-surfactant solution. When the liquids were mixed rapidly, tiny emulsion droplets formed. As the mixture cooled, the fluids in each of the droplets separated, resulting in droplets within droplets. To manipulate the droplets' optical properties, the researchers added certain concentrations and ratios of various surfactants—chemical compounds that lower the interfacial tension between two liquids. In this case, one of the surfactants the team chose was a light-sensitive molecule. When exposed to ultraviolet light this molecule changes its shape, which modifies the tension at the droplet-water interfaces and the droplet's focusing power. This effect can be reversed by exposure to blue light. "We can change focal length, for example, and we can decide where an image is picked up from, or where a laser beam focuses to," Kolle says. "In terms of light guiding, propagation, and tailoring of light flow, it's really a good tool."

Optics on the horizon

Kolle and his colleagues tested the properties of the microlenses through a number of experiments, including one in which they poured droplets into a shallow plate, placed under a stencil, or "photomask," with a cutout of a smiley face. When they turned on an overhead UV lamp, the light filtered through the holes in the photomask, activating the surfactants in the droplets underneath. Those droplets, in turn, switched from their original, flat interface, to a more curved one, which strongly scattered light, thereby generating a dark pattern in the plate that resembled the photomask's smiley face. The researchers also describe their idea for how the microlenses might be used as pocket-sized microscopes. They propose forming a microfluidic device with a layer of microlenses, each of which could capture an image of a tiny object flowing past, such as a blood cell. Each image

would be captured from a different perspective, ultimately allowing recovery of information about the object's three-dimensional shape. "The whole system could be the size of your phone or wallet," Kolle says. "If you put some electronics around it, you have a microscope where you can flow blood cells or other cells through and visualize them in 3-D." He also envisions screens, layered with microlenses, that are designed to refract light into specific directions. "Can we project information to one part of a crowd and different information to another part of crowd in a stadium?" Kolle says. "These kinds of optics are challenging, but possible."

(Источник: https://phys.org/physics-news)

TASKS

1.**What is the main idea of the text? Choose the correct answer.**

a) Scientists discovered a new way of making lenses.

b) Scientists learned how to make double emulsions.

c) Scientists studied interfacial tension in water—surfactant compounds.

2. Mark true (T) or false(F) sentences.

a) Microlenses consist of two droplets of different liquids, one inside another. (T/F)

b) Liquid microlenses are not tunable, but researchers try to solve this problem.(T/F)

c) As scientists envision, pocket-sized microscope would help in studying the human brain. (T/F)

d) Adding various surfactants allows changing shape of droplet. (T/F)

e) Optic systems based on this new idea would make images of object inside from different angles. (T/F)

3. In which paragraph is it written that liquid droplets can be used to magnify images of different objects?

a) 2 b) 1 c) 3

4. Put the names of paragraphs in the correct order.

1. Complex combination.

2. Amazing magnifiers.

3. New possibilities.

a) 1, 2, 3 b) 3, 2, 1 c) 2, 1, 3

5. Choose the correct answer to the given question.

How do researchers change the shape of microlenses?

a) They do it using surfactants that react to UV and blue light.

b) They do it using nanoparticles of ferromagnets suspended in water that react to electromagnetic field.

c) They do not do it because they have hot found out how to do it yet.

6. Choose the correct translation of the given sentence.

We can create complex geometries that form lenses, and these lenses can be tuned optically.

a) Мы можем создавать комплексные геометрии которые создают линзы, и эти линзы могут ясно звучать.

b) Мы можем создавать геометрические комплексы которые образуют объективы, и их линзы могут оптически настраиваться.

c) Мы можем создавать сложные структуры которые принимают форму линз, и эти линзы могут быть оптически настраиваемы.

7. Match column A and B

A	**B**
1. surfactant	a) пробирка
2. interface	b) взвешенный
3. suspended	c) применение
4. vial	d) граница раздела сред
5. application	e) поверхностно-активное вещество

8.Complete the sentence.

This interface acts as a kind of internal lens, …

a) the fluids in each of the droplets separated, resulting in droplets within droplets.

b) comparable to the compounded lens elements in microscopes.

c) you can dream up all sorts of applications.

9. Choose the sentence with correct word order.

a) They this week report the advance in the journal Nature Communications.

b) The whole system could be the size of your phone or wallet.

c) We have fluids shown optically are very versatile.

10. Fill in the gap with appropriate word.

The scientists used a combination of chemistry and light to precisely shape the _____ of the interface between the internal bead and the surrounding droplet.

a) geometry

b) surfactant

c) curvature

KEYS

Check your answers

1-a; 2. a) T, b)F, c)F d)T e)T; **3 –a; 4 –c;5-a;6-c; 7.** 1-e, 2-d, 3-b, 4-a, 5-c; 8-b; 9-b; 10-c.

Text 2. PHYSICISTS PREDICT THE EXISTENCE OF UNUSUAL OPTICAL COMPOSITES

VOCABULARY

1) dielectric [daɪˈlektrɪk] диэлектрик

2) composite [ˈkɒmpəzɪt] составной

3) birefringence [bɪˈrefrɪnʤəns] двулучеприломление

4) polarization [pəʊləraɪˈzeɪʃn] поляризация

5)electromagnetic field [ɪlektrəʊmægˈnetɪk][fiːld]

электромагнитное поле

6) oscillation [ˈɒsɪleɪt] колебание

7) chaotic [keɪˈɒtɪk] хаотичный

8) optical axis [ˈɒptɪkəl][ˈæksɪs] оптическая ось

9) gyrotropic гиротропный

10) rotation [rəʊˈteɪʃən] вращение

11) isotropic изотропный

12) surface [ˈsɜːfɪs] поверхность

13) spatial [ˈspeɪʃəl пространственный

14) beam [biːm] луч

15) to split [splɪt] расщепить

Read the text and translate it into Russian.

TEXT

1.Physicists from MIPT have predicted the existence of transparent composite media with unusual optical properties. Using graphics card-based simulations, scientists studied regular volume structures composed of two dielectrics with close parameters, and found that the optical properties of these structures differ from both those of natural crystals and artificial periodic composites, which are currently attracting a lot of interest.

The theoretical study conducted by senior researcher Alexey Shcherbakov and sixth-year student Andrey Ushkov, who both work in the Laboratory of Nanooptics and Plasmonics, is devoted to specific composite media that were simulated by means of an approach elaborated by the group. These media allow for the existence of an effect called birefringence—when illuminated by a light beam, the original beam splits in two inside the medium. In their article published in Optics Express, the physicists predicted the existence of composite crystal structures of a new type, in which birefringence occurs in a rather different manner to the way it does in natural crystals.

2.The splitting of a beam in two in birefringent materials is due to the dependence of the properties of a crystal on the direction of light wave propagation, and the

polarization of light waves. Polarization is the direction of the electromagnetic field oscillations in the wave; ordinary light is a chaotic mixture of waves with different polarizations.

To understand polarization, imagine a long rope attached at one end to a wall. If someone stretches the rope and starts to periodically move the free end of the rope, waves will appear. The free end can be moved either horizontally or vertically. The whole rope would then move either in a horizontal or vertical plane respectively, and these are the two different polarizations of waves in the rope.

When the light propagates through a birefringent crystal, some of the waves with one polarization shift in one direction, whereas the others, with another polarization, shift in a different direction. Using this property, researchers can use the crystal to filter partly or fully polarized light depending on the polarization state of the initial incident beam. This phenomenon could have been used by Vikings, who detected the position of the sun in a cloudy sky with Iceland spar. Nowadays, birefringent crystals are widely used in laser techniques.

3.The theory of birefringence involves the concepts of optical axis and isofrequency surface. The first term refers to a direction in the crystal in which the incident wave does not split in two. For example, Iceland spar has a single optical axis, and salt crystals have none, as they do not possess birefringence. There are materials with two optical axes, such as Glauber's salt, the basic constituent of which is widely used in the glass industry and detergent manufacture. Within classical crystal optics, excluding magnetic and gyrotropic (related to polarization rotation) effects, all crystals are divided into three types: isotropic, and anisotropic with one or two optical axes.The second concept, isofrequency surface, illustrates the dependence of the speed of light in a crystal on spatial direction.

This surface is drawn in such a way that the length of a vector starting from the coordinate frame origin and ending at a surface point equals the ratio of the speed of light in a vacuum to the speed of light in the crystal in the direction indicated by the vector. The isofrequency surface of an isotropic crystal is a sphere whose radius is equal to the crystal refractive index since the light propagates in an

isotropic medium at the same speed in any direction. The refractive index of transparent materials is always greater than unity.

For birefringent media, the shape of the isofrequency surface differs from the sphere. Moreover, the surface itself looks as if it consists of two parts, an inner and an outer part. These two parts illustrate how slower the light propagates in the crystal than in a vacuum in each direction for two different light polarizations. Points where the parts of the surface intersect indicate the optical axes, directions in which the speed of light does not depend on the polarization. The figure below shows isofrequency surfaces for salt, Iceland spar and Glauber's salt.

Beyond classical crystal optics, the basics of which are commonly taught to physics students, it appears that even crystals with a simple cubic lattice, such as salt, are optically anisotropic, i.e., the light there propagates in different directions differently. In the simplest case, this anisotropy was described by Hendrik Lorentz in the early 20th century. As many as seven optical axes were found in such crystals. This effect was confirmed experimentally in the late 20th century when scientists began to use lasers in research. However, the two parts of the isofrequency surface appeared to be almost indistinguishable (a relative difference of an order of 10-5-10-6), so that such anisotropy practically vanishes. In modern technologies, it is only taken into account in ultra-high-precision optical projection mountings for deep ultraviolet nanolithography, which is used in modern microelectronic fabrication.

In addition to natural crystals, such as birefringent Iceland spar, scientists are able to manipulate the crystal structure using artificial materials. Advances in micro and nanofabrication during the last two decades pushed studies of these artificial materials, including metamaterials and photonic crystals, toward the edge of optical science. The regular atomic or molecular arrangement is replaced by a regular geometric pattern in these structures. This pattern can be compared with an ornamental design on a wooden jewel box, but in three dimensions and with a scale from dozens of nanometers to hundreds of micrometers.

Artificial regular structures, photonic crystals and metamaterials can exhibit rather unusual optical properties, which dramatically differ from the properties of natural crystals. For example, periodical structuring at micro and nano scales enables scientists to overcome the diffraction limit on microscope resolution, and create flat lenses. Metamaterials can have a negative refractive index and be strongly optically anisotropic. The new article by Alexey Shcherbakov and Andrey Ushkov bridges the gap between natural crystals and the mentioned artificial photonic materials, and describes optical composites which on the one hand cannot be described within the scope of classical crystallography, and on the other hand are not traditional photonic crystals or metamaterials.

The authors of the newly published research used their own model and method, which they ran on NVidia graphics processing units, to simulate composite dielectrics periodically structured in three dimensions, i.e., a 3-D lattice of two transparent materials. In contrast to metamaterials and photonic crystals, where the optical contrast between lattice constituents is strong, MIPT physicists studied a combination of low refractive index and low optical contrast media with a relatively small period, about one tenth of the wavelength. Despite the fact that this combination was not commonly implicitly assumed to yield any interesting effects, the research demonstrated that some interesting physical phenomena were overlooked.

For low values of periods of investigated structures their optical properties are indeed indistinguishable from the optical behavior of natural crystals: composites with a cubic lattice are practically isotropic, whereas composites with, for example, tetragonal and orthorhombic lattices display uniaxial and biaxial properties. However, increasing the period while keeping valid the description of the composite as an effective medium, as the authors demonstrated, can cause very unusual behavior.

First, there appear new optical axes (up to ten axes in an orthorhombic crystal). Moreover, while the directions of optical axes are fixed within classical crystallography, the directions of some of the new optical axes turn out to be

dependent on the period to wavelength ratio. Second, in the direction where the maximum difference of the speed of the light for two polarizations occurs for small periods (the maximum distance between the two parts of the isofrequency surface), this difference can practically go to zero, or, in other words, the direction can become an optical axis, at a certain relatively large period. Besides, owing to the use of the rigorous method, the authors obtained quantitative assessments on the validity of the effective medium approximation.

"Scientists actually mentioned that it may be possible for a crystal to possess numerous optical axes in the mid-20th century—this was stated, for example, by the Russian Nobel prize winner Vitaly Ginzburg. However, in natural crystals such effects are impossible due to the smallness of the period, and there were no technologies to fabricate a good quality composite. Additionally, the power of computing machines was also insufficient to estimate the necessary corrections to anisotropic dielectric permittivity coming from lattice anisotropy. Our result is based on the joint use of modern methods of computational physics together with the high computing power provided by graphics cards. In our work we also developed an approach which allows us to calculate an effective optical response of a complex composite with controlled precision by virtue of so called first principle calculations (in our case, a rigorous solution of Maxwell's equations)," said Alexey Shcherbakov describing the results.

Possibilities for practical applications may come after experimental validation of the theoretical predictions. Modern technologies allow in principle the fabrication of composites of interest for operation in various optical bands. For example, 3-D high resolution multiphoton lithography can be used for the infrared band, whereas for the terahertz band one can apply microstereolithography. The discovered effects make artificial crystal anisotropy strongly dependent on the radiation wavelength, which in not the case for transparent natural crystals. This may enable scientists to develop new types of optical polarization control elements.

(Источник: https://phys.org/physics-news)

TASKS

1.What is the main idea of the text? Choose the correct answer.

a)The benefits of the existence of transparent composite media with unusual optical properties.

b)The possibilities are achieved by predicting the existence of transparent composite media with unusual optical properties.

c) c)Fire fringing crystals are widely used in laser techniques.

2.Mark true (T) or false(F) sentences.

a) Optical properties of these structures the same with both those of natural crystals and artificial periodic composites(T/F)

b) Ordinary light is a chaotic mixture of waves with similar polarizations.(T/F)

c)To understand the polarization, the authors cite an the example of a long rope attached to a wall.(T/F)

d)The Vikings found the position of the sun using polarization.(T/F)

e)Within classical crystaloptics all crystals are divided into two types.(T/F)

3.In what paragraph it is said what the ordinary light is?

1)

2)

3)

4.Put the names of paragraphs in the correct order.

1. The concepts involved in the theory of birefingence.
2. Polarization properties.
3. The composite crystal structures of a new type.

a) 1,2,3

b) 3,2,1

c) 2,1,3

5. Choose the correct answer to the given question.

What kind of household example do the authors give to understand the polarization?

a) Skipping a beam of light through the crystal.

b) Vikings, who detected the position of the sun in a cloudy sky with Iceland spar.

c) A long rope attached at one end to a wall.

6. Choose the correct translation of the given sentence.

The theoretical study conducted by senior researcher Alexey Shcherbakov and sixth-year student Andrey Ushkov, who both work in the Laboratory of Nanooptics and Plasmonics, is devoted to specific composite media that were simulated by means of an approach elaborated by the group.

a)Теоритическое исследование главного научного сотрудника Алексея Щербакова и студента шестого курса Андрея Ушкова, работающих в лаборатории нанооптики и плазмоники, посвященные конкретным компазиционным материалам, былои смоделированно с помощью подхода, разработанного группой.

b)Теоретическое исследование, проведенное старшим научным сотрудником Алексеем Щербаковым и студентом шестого курса Андреем Ушковым, которые оба работают в Лаборатории нанооптики и плазмоники, посвящено конкретным композиционным материалам, которые были смоделированы с помощью подхода, разработанного группой. c)Теоретические исследования, проведенное старшим научным сотрудником Алексеем Щербаковым и студентом шестого курса Андреем Ушковым, которые оба работают в Лаборатории нанооптики и плазмоники, посвящено конкретным композиционным материалам, которые были смоделированы с помощью подхода, разработанного группой.

7.Match column A and B

1.rotation	4.spatial
2.oscillation	5.birefringence
3.electromagnetic field	a)колебание

b)электромагнитное поле

c)пространственный

d)двулучепреломление

e)вращение

8.Complete the sentence.

Polarization is....

a) is a chaotic mixture of waves

b) the direction of the electromagnetic field oscillations in the wave

c)isofrequency surface

9. Choose the sentence with correct word order.

a)Imagine at one end to a wall a long attached rope to understand the polarization.

b)To understand polarization, imagine a attached long rope at one end to a wall.

c)To understand polarization, imagine a long rope attached at one end to a wall.

10.Fill in the gap with appropriate word

These media allow for the existence of an effect called .....—when illuminated by a light beam, the original beam splits in two inside the medium.

a)oscillation

b)polarization

c)birefringence

KEYS

Check your answers

1)b; 2)a-F, b-F, c-T, d-T, e-F; 3)2; 4)b; 5)c; 6)b;

7) 1-e;2-a;3-b;4-c;5-d; 8)b; 9)c; 10)c.

Text 3. RESEARCHERS FLIP A MAGNETIC MEMORY CELL WITH A LIGHT PULSE AT RECORD SPEED

VOCABULARY

1. microelectronics [mʌɪkrəʊɪlɛkˈtrɒnɪks] микроэлектроника

2. magnetization [mægnɪtaɪˈzeɪʃən] намагниченность

3. silicon transistors [sɪlɪk(ə)n trænˈzɪstəz] кремниевые транзисторы

4. gadolinium [gadəˈlɪnɪəm] гадолиний

5. light pulses [lʌɪt pʌlsɪs] световые импульсы

6. electrode [ɪˈlɛktrəʊd] электрод

7. fibers [faɪbərs] волокна

8. infrared light [ɪn.frəˈred lʌɪt] инфракрасное излучение

9. microseconds [maɪkrəʊˌsekəndz] микросекунды

10. picosecond [pɪkəˈsekənd] пикосекунда

11. potential [pə(ʊ)ˈtɛnʃ(ə)l] потенциал (в техническом смысле)

12. non-volatile [nɒnˈvɒlətʌɪl] нелетучий

13. high-density [haɪ-ˈdensɪtɪ] высокая плотность

14. neuron [njʊərɒn] нейрон

15. synapse [sʌɪnaps] синапс

Read the text and translate it into Russian.

TEXT

1.University of Minnesota electrical and computer engineering researchers have created a magnetic tunnel junction that can be switched by a pulse of light lasting one trillionth of a second—a new record. The magnetic tunnel junction is critical to information technology advances with the termination of Moore's law, a principle that has ruled the microelectronics industry for five decades.

2.This advancement holds promise for the development of new, optically controlled, ultrafast magnetic devices collectively called spintronics (electronics that combine optical and magnetic nanotechnologies). These devices could lead to innovations in the storage, processing, and communication of information. An example of such innovation would be the development of a system that, like the human brain, can both store and analyze a large amount of data simultaneously. The details of the device and the tests conducted on it are reported in a paper published recently in Physical Review Applied, a journal of the American Physical Society.

3.Typically, the magnetic tunnel junction has a "sandwich-like" structure comprised of two layers of magnetic materials with an insulating layer, called barrier, in the middle. Information is written on the magnetic material by reversing the magnetization of one of the layers. This reversing process often involves spiral motion in the spinning electrons, called spin processing. However, there is a limitation on how fast the spin processing can be. The brakes are applied at roughly 1.6GHz, a current speed record that is much slower than silicon transistors. To enable faster writing speeds, the limitations on speed have to be overcome.

"With our invention of a new magnetic tunnel junction, there is now a way to speed things up," said Mo Li, an associate professor in the University of Minnesota Department of Electrical and Computer Engineering who led the research.

Inspired by the 2007 discovery by Dutch and Japanese scientists showing that the magnetization of an alloy of a rare earth element, called gadolinium (Gd), with iron (Fe), and cobalt (Co) could be switched using light pulses, University of Minnesota researchers used the alloy to replace the upper magnetic layer of a conventional magnetic tunnel junction. Another modification they made to the device was to use a transparent electrical material called indium tin oxide for the electrode to allow light to pass through it. These layers are stacked into a pillar with a diameter of 10 μm, which is only one-tenth the diameter of a typical human hair.

To test their work, researchers sent laser pulses to the modified device using a low-cost laser based on optical fibers that emits ultrashort pulses of infrared light. The pulses are sent one in every microsecond (one millionth of a second), but each pulse is shorter than one trillionth of a second. Every time a pulse hit the magnetic tunnel junction pillar, the scientists observed a jump in the voltage on the device. The change in voltage confirms that the resistance of the magnetic tunnel junction "sandwich" changes each time the magnetization of the GdFeCo layer is switched. Because each laser pulse lasts less than 1 picosecond (a millionth of a microsecond), the device is capable of receiving data at an amazing rate of 1 terabit per second.

Li said the research holds exciting prospects. "Our result establishes a new means of communication between fiber optics and magnetic devices. While fiber optics afford ultra-high data rate, magnetic devices can store data in a non-volatile way with high density," he said.

Professor Jian-Ping Wang, director of the Center for Spintronic Materials, Interfaces, and Novel Structures (C-SPIN) based at the University of Minnesota and co-author of the study, also sees great promise. "The results offer a path toward a new category of optical spintronic devices that have the potential to address future challenges for developing future intelligent systems.

"These systems could use spin devices as neurons and synapses to perform computing and storage functions just like the brain, while using light to communicate the information," Wang said.

The ultimate goal for the research team is to shrink the size of the magnetic tunnel junction to less than 100 nanometers and reduce the required optical energy. To this end, the team is continuing its research, and is currently engaged in optimizing the material and structure of the device, and working on integrating it with nanophotonics. In addition to Li and Wang, postdoctoral associate Junyang Chen, and graduate student Li He are lead authors of the paper.

(Источник: https://phys.org/physics-news)

TASKS

1.What is the main idea of the text? Choose the correct answer.

a) Researchers from the University of Minnesota took first place at the Olympics in robotics.

b) Researchers from the University of Minnesota created a magnetic tunnel junction, which terminates Moore's law.

c) The University of Minnesota created switches that respond to light pulses.

2.Mark true (T) or false (F) sentences.

a) This device leads to innovations in the field of storage, processing and transmission of data. (T/F)

b) Once again, scientists can not violate Moore's law. (T/F)

c) Scientists have created a system that is capable of working with information as a human brain. (T/F)

d) There is a limitation on the speed of the spin processor of about 1.6 GHz. (T/F)

e) Information is recorded on a magnetic material by changing the magnetization of one of the layers. (T/F)

3.In what paragraphs is it written that in the future, it is possible to develop a system that can function as a human brain.

a)3

b).2

c).1

4.Put the names of paragraphs in the correct order.

1. Promising advancement in spintronics.
2. Good news from the University of Minnesota.
3. About the structure of the magnetic tunnel junction.

a) 1, 2, 3

b) 3, 2, 1

c) 2, 1, 3

5. Choose the correct answer to the given question.

What structure does the magnetic tunnel junction have?

a) It has a "sandwich structure" consisting of two layers of magnetic materials with an insulating layer, called a barrier.

b) Has a "complex structure" consisting of a single solid layer of magnetic material.

c) Large size, very similar to a sandwich.

6. Choose the correct translation of the given sentence.

Information is written on the magnetic material by reversing the magnetization of one of the layers.

a) Записанная информация стирается с помощью намагничивания, где следующим слоем записывается снова.

b) Информация записывается магнитом путем перебора магнитных слоёв.

c) Информация записывается на магнитном материале путем изменения намагничивания одного из слоёв.

7.Match column A and B

1. pulses(e) a) нанофотоника
2. transparent(c) b) оптический спинтроник
3. fiber optic(d) c) прозрачный
4. optical spintronic(b) d) оптоволокно
5. nanophotonics(a) e) импульсы

8.Complete the sentence.

British scientists are more advanced, because…sponsored…state

a) they, by

b) they are, by the

c) it, on the

9. Choose the sentence with correct word order.

a) Are layers these stacked into a with pillar a diameter of 10 μm, which is only one-tenth the diameter of a typical human hair.

b) Which is only one-tenth the diameter of a typical human hair, these layers are stacked into a pillar with a diameter of 10 μm.

c) These layers are stacked into a pillar with a diameter of 10 μm, which is only one-tenth the diameter of a typical human hair.

10.Fill in the gap with appropriate word

Because each laser pulse lasts less than 1 picosecond (a … of a microsecond)

a) billion

b) millionth

c) hundred

KEYS

Check your answers

1.-b; 2.a) T, b) F, c) T, d) T, e) T. 3.- 2; 4.- c; 5.- a; 6.- c;

7. 1-e, 2- c, 3-d, 4-b, 5-a 8-b; 9 - c; 10- b

Text 4. NEW WAY TO TUNE ELECTRONIC ENERGY LEVELS MAY LEAD TO VALLEYTRONIC DEVICES

VOCABULARY

1. populate - |ˈpɑːpjuleɪt| - заселять
2. develop - |dɪˈvɛləp| - развивать
3. tungsten - |ˈtʌŋst(ə)n| - вольфрам
4. tune - |tjuːn| - настраивать
5. frequency - |ˈfriːkw(ə)nsi| - частота
6. shift - |ʃɪft| - перемещение
7. resonance - |ˈrɛz(ə)nəns| - резонанс
8. hybrid - |ˈhʌɪbrɪd| - гибридный
9. intensity - |ɪnˈtɛnsɪti| - интенсивность
10. solid - |ˈsɒlɪd| - твердое тело
11. disentangle - |dɪsɪnˈtaŋg(ə)l| - распутывать
12. enhance - |ɪnˈhɑːns| - усиливать
13. dimension - |dɪˈmɛnʃ(ə)n| - измерение
14. predict - |prɪˈdɪkt| - предсказывать
15. property - |ˈprɒpəti| - свойства

Read the text and translate it into Russian.

TEXT

1. Faster, more efficient data storage and computer logic systems could be on the horizon thanks to a new way of tuning electronic energy levels in two-dimensional films of crystal, discovered by researchers at MIT.

The discovery could ultimately pave (вымостить) the way for the development of so-called "valleytronic" devices, which harness (запрягать) the way electrons gather around two equal energy states, known as valleys.

2. Engineers have for some time warned that we are reaching the limits of how small we can build conventional (обыкновенный) electronic transistors, which are based on electrons' electrical charge. As a result, researchers have been

investigating the utility of a property of electrons known as spin, to store and manipulate data; such technologies are known as spintronics.

3. But as well as their charge and spin, electrons in materials also have another "degree of freedom," known as the valley index. This is so-called because plotting the energy of electrons relative to their momentum results in a graph consisting of a curve with two valleys, which are populated by electrons as they move through a material. Harnessing this degree of freedom could allow information to be stored and processed in some materials by selectively populating the two valleys with electrons.

However, developing such valleytronic devices requires a system to selectively control the electrons within the two valleys, which has so far proven very difficult to achieve. Now, in a paper published today in the journal Science, researchers led by Nuh Gedik, an associate professor of physics at MIT, describe a new way of using laser light to control the electrons in both valleys independently, within atomically thin crystals of tungsten disulfide.

"The two valleys are exactly at the same energy level, which is not necessarily the best thing for applications because you want to be able to tune them, to change the energy slightly so that the electrons will move [from the higher] to the lower energy state," Gedik says.

Although this can be achieved by applying a magnetic field, even very powerful laboratory magnets with a strength of 10 tesla are only capable of shifting the valley energy level by around 2 millielectronvolts (meV)

The researchers have previously shown that by directing an ultrafast laser pulse, tuned to a frequency very slightly below the resonance of the material, they were able to shift the energy of one of the valleys through an effect called the "optical Stark effect," while leaving the other valley virtually unchanged. In this way they were able to achieve a shift in energy level of up to 20 meV.

"The light and the electrons inside the material form a type of hybrid state, which helps to push the energy levels around," Gedik says.

In the latest experiment, the researchers discovered that by tuning the laser frequency to even further below resonance, and increasing its intensity, they were able to simultaneously shift the energy levels of both valleys and reveal a very rare physical phenomenon.

While one valley still shifts as a result of the optical Stark shift as before, the other valley shifts through a different mechanism, known as the "Bloch-Siegert shift," according to MIT physics PhD student Edbert Jarvis Sie, the paper's lead author.

Although the Bloch-Siegert shift was first predicted in 1940, and soon after helped inspire Willis Lamb to his 1955 Nobel Prize-winning discovery of the Lamb shift in hydrogen atoms, it has remained a considerable challenge to observe it experimentally in solids.

Indeed, apart from so-called artificial atoms, the new mechanism has never been observed in solids until now, because the resulting shifts were too small, Sie says. The experiment performed at the Gedik Lab produced a Bloch-Siegert shift of 10 meV, which is 1,000 times larger than that seen previously.

What's more, the two effects—the Bloch-Siegert shift and optical Stark shift—have previously tended to take place in the same optical transition, meaning researchers have had difficulty disentangling the two mechanisms, Sie says.

"In our work we can disentangle the two mechanisms very naturally, because while one valley exhibits the optical Stark shift, the other valley exhibits the Bloch-Siegert shift," Sie says. "This can work so nicely in this material because the two mechanisms have a similar relationship with the two valleys. They are related by what is called time-reversal symmetry."

This should allow for enhanced control over valleytronic properties in two-dimensional materials, Nuh says. "It could give you more freedom in tuning the electronic valleys," he says.

(Источник: https://phys.org/physics-news)

TASKS

1.What is the main idea of the text? Choose the correct answer.

a)New technologies – spintronics.

b)Invention of valleytronic devices.

c)An important contribution to science of MIT.

2. Mark true (T) or false (F) sentences.

a) There is a new of tuning electronic energy levels in three-dimensional films of crystal (T/F)

b) This can lead us to a new invention. (T/F)

c) The researches were done in MIT. (T/F)

d) Conventional electronic transistors are based on protons' electrical charge. (T/F)

e) Electrons have 3 important characteristics. (T/F)

3. In what paragraphs is it written that (The limit of transistors' size)?

a) 1

b) 2

c) 3.

4.Put the names of paragraphs in the correct order.

1. Evolution of data storage systems.
2. The use of valley index.
3. Useful properties of electron.

a) 1,3,2

b) 1,2,3

c) 2,3,1

5. Choose the correct answer to the given question.

What is the name of energy states that electrons gather around?

a) Spins

b) Degree of freedom

c) Valleys

6. Choose the correct translation of the given sentence.

Harnessing this degree of freedom could allow information to be stored and processed in some materials by selectively populating the two valleys with electrons.

a)Использование этой степени свободы может позволить хранить информацию и обрабатывать ее в некоторых материалах, избирательно заполняя две долины электронами.

b) Новый способ настройки электронных уровней может привести к новому виду устройств.

c) Разработка таких устройств требует от системы избирательного контроля за электронами на двух долинах, что оказалось сложной задачей.

7. Match column A and B

1. a negatively charged subatomic particle

2. a device that regulates current or voltage flow and acts as a switch or gate for electronic signals.

3. the number of parameters of the system that may vary independently

4. one of the basic properties of the elementary particles of matter giving rise to all electric and magnetic forces and interactions

a) electron

b) transistor

c) degree-of-freedom

d) electrical charge

8. Complete the sentence.

Harnessing this degree of freedom could allow information to be stored and processed in some materials by selectively populating the two _____ with electrons.

a)valleys

b) electrons

c) degrees of freedom

9. Choose the sentence with correct word order.

a) Faster, more efficient data storage and computer logic systems could be on the horizon thanks to a new way of tuning electronic energy levels in two-dimensional films of crystal, discovered by researchers at MIT.

b) This electrons relative is so-called plotting because the energy of to their momentum results in a of a curve with two valleys, which are populated by graph consisting electrons as they move through a material

c) As a result, been investigating the utility of a property of electrons , researchers have known as spin, to data; such technologies are store and manipulate known as spintronics.

10. Fill in the gap with appropriate word

Engineers have for some time warned that we are reaching the limits of how small we can build conventional electronic _____ , which are based on electrons' electrical charge.

a) device

b) transistor

c) matrix

KEYS

Check your answers

1)b; 2)1-F, 2-T, 3-T, 4-F, 5-T; 3)b; 4)a; 5)c; 6)a;

7)1-a 2-b 3-c 4-d; 8)a; 9)a; 10)b

Text 5. IBM RESEARCHERS CREATE WORLD'S SMALLEST MAGNET

VOCABULARY

1. atom [ˈætəm] атом
2. researcher [rɪˈsɜːtʃ] исследователь
3. magnetic storage [mægˈnet.ɪk] [ˈstɔː.rɪdʒ] магнитное запоминающее устройство
4. hard drive [hɑːd] [draɪv] жесткий диск
5. dense [dens] плотный
6. holmium [ˈhəʊlmɪəm] гольмий
7. oxide [ˈɒk.saɪd] оксид
8. electric current [ɪˈlektrɪk] [ˈkʌrənt] электрический ток

9. magnetic current [mægˈnet.ɪk]
10. [ˈkʌrənt] магнитный ток
11. bit of information [ˌɪnfəˈmeɪʃn] бит информации
12. scanning tunneling microscope [ˈskænɪŋ] [ˈtʌn.əl] [ˈmaɪ.krə.skəʊp] сканирующий туннельный микроскоп
13. probe [prəʊb] зонд
14. magnetic orientation [mægˈnet.ɪk] [ˌɔː.ri.enˈteɪ.ʃən] магнитная ориентация
15. state [steɪt] состояние
16. approximately [əˈprɒksɪmətli] приблизительно

Read the text and translate it into Russian.

Text.

1.An international team of researchers working at IBMs' San Jose research facility announced recently that they had created the world's smallest magnet—it was made from a single atom. In their paper published in the journal Nature, the team describes their achievement as the ultimate limit in reducing the size of magnetic storage media using the classical approach—they report that they were able to use the tiny magnet to store a single bit of data.

2.Ever since hard drives were invented, scientists have been hard at work trying to figure out ways to make them smaller while at the same time developing ways to make them more dense so that they can hold more information. As the team at IBM notes, currently, it takes approximately 100,000 atoms to hold a single bit of information. If a technique could be found to commercialize their single-atom approach, they further note, it would allow for holding something as massive as Apple's iTunes library of songs on something as small as a credit card.

3.To create their tiny magnet, the team used a scanning tunneling microscope to manipulate holmium atoms placed on a magnesium oxide plate (to keep the magnetic poles stable). Applying an electric current to the microscope's probe allowed for changing the magnetic orientation of the atom between two states,

which, the team notes, could be used to represent on/off states for a single bit of data. To read the state, the team measured the magnetic current passing through the atom. The team notes also that the state of several atoms could be read or written when the atoms were as close as a single nanometer apart.

IBM has been investing heavily in scanning tunneling microscope research for decades, a technology they have been credited with inventing (Gerd Binnig and Heinrich Rohrer won the Nobel Prize in physics for this accomplishment back in 1986). Recently, they also announced that they had developed a new technique that offered a better way to measure the magnetic field of individual atoms and in a somewhat related development, also announced that they would be offering the world's first commercial "universal" quantum-computing service.

(Источник: https://phys.org/physics-news)

TASKS

1.What is the main idea of the text? Choose the correct answer.

a) Creation of a tiny magnet

b) The «Nature» journal

c) Varieties of the microscopes

2. Mark true (T) or false (F) sentences.

a) The world's smallest magnet was made from a single atom (T/F)

b) IBM team increased the size of magnetic storage (T/F)

c) It took 250,000 atoms to hold a single bit of information (T/F)

d) IMB team used a X-RAY microscope to manipulate holmium (T/F)

e) If the atoms are close as a single nanometer apart we can read their state (T/F)

3. In what paragraphs is it written that an electric current can change the magnetic orientation?

a) 1

b) 2

c) 3

4. Put the names of the paragraphs in the correct order.

1) Usefulness of the microscopes
2) After the invention of the hard drivers
3) A huge achievement

a) 1,2,3
b) 3,2,1
c) 2,1,3

5. Choose the correct answer to the given question.

What did the IBM team measure to read the state of the atom?

a) The magnetic current
b) The electric current
c) The temperature outside

6. Choose the correct translation of the sentence.

An international team of researchers working at IBMs' San Jose research facility announced recently that they had created the world's smallest magnet—it was made from a single atom

a) Многонациональная команда исследователей, работающая на научном объекте IBM в Сан Хосе, объявили что недавно они создали самый маленький в мире магнит - он был сделан из единственного атома

b) Многонациональная команда слесарей, работающая на заводе IBM в Сан Хосе, объявили что в скором времени они создадут самый большой в мире котел

c) Многонациональная команда путешественников, работающая на научном объекте IBM в Сан Хосе, объявили что недавно они создали один из самых маленьких в мире магнитов - он был сделан из единственного атома

7. Match column A and B.

A B

1.approach	a)измерять
2.to figure out	b)отчет
3.facility	c)объект
4.report	d)выяснить
5.to measure	e) подход

8. Complete the sentence.

As the team at IBM notes, currently, it takes approximately…

a) 100,000 atoms to hold a single bit of information.

b) 500,000 ions to hold a single bit of information.

c) 100,000 atoms to hold a lot of information.

9. Choose the sentence with the correct word order.

a) To read the state, the team measured the magnetic current passing through the atom.

b) The team notes also that the several of state atoms could be read or written when the atoms close as were as a single nanometer apart.

c) An international researchers of team working at IBMs' Jose San research facility announced recently that they had created the world's magnet smallest—it was made from a atom single.

10. Fill in the gap with appropriate word.

To create their tiny magnet, the team used a scanning tunneling microscope to manipulate holmium atoms placed on a _____ plate (to keep the magnetic poles stable).

a) magnesium oxide

b) magnesium hydroxide

c) chlorine oxide

KEYS

Check your answers

1)a; 2)a-T, b-F, c-F, d-F, e-T; 3)c; 4)b; 5)a; 6)a;

7)1-5; 2-4; 3-3; 4-2; 5-1; 8)a; 9)a; 10)a

Text 6. RESEARCHERS CREATE 'TIME CRYSTALS' ENVISIONED BY PRINCETON SCIENTISTS

VOCABULARY

1. pattern [ˈpætən] структура
2. frequency [ˈfriːkwənsɪ] частота
3. fluid [ˈfluːɪd] жидкость
4. explore [ɪksˈplɔː] исследовать
5. equilibrium [iːkwɪˈlɪbrɪəm] равновесие
6. quantum system [ˈkwɔntəm ˈsɪstɪm] квантовая система
7. oscillations [ɔsɪˈleɪʃn] колебания
8. research [rɪˈsɜːʧ] исследовательская работа
9. three-dimensional [triːdɪˈmenʃənl] трёхмерный
10. hexagonal lattice [hekˈsægənl ˈlætɪs] шестиугольная решётка
11. space [speɪs] пространство
12. phase [feɪz] фаза
13. translation symmetry [trænsˈleɪʃn ˈsɪmɪtrɪ] трансляционная симметрия
14. syntethic [sɪnˈθetɪk] искусственный
15. crystalline [ˈkrɪstəlaɪn] кристаллический

Read the text and translate it into Russian.

TEXT

1.Time crystals may sound like something from science fiction, having more to do with time travel or Dr. Who. These strange materials in which atoms and molecules are arranged across space and time are in fact quite real, and are opening up entirely new ways to think about the nature of matter. They also eventually may help protect information in futuristic devices known as quantum computers.

Two groups of researchers based at Harvard University and the University of Maryland report March 9 in the journal Nature that they have successfully created time crystals using theories developed at Princeton University. The Harvard-based team included scientists from Princeton who played fundamental roles in working out the theoretical understanding that led to the creation of these exotic crystals.

"Our work discovered the essential physics of how time crystals function," said Shivaji Sondhi, a Princeton professor of physics. "What is more, this discovery builds on a set of developments at Princeton that gets at the issue of how we understand complex systems in and out of equilibrium, which is centrally important to how physicists explain the nature of the everyday world."

In 2015, Sondhi and colleagues including then-graduate student Vedika Khemani, who earned her Ph.D. at Princeton in 2016 and is now a junior fellow at Harvard, as well as collaborators Achilleas Lazarides and Roderich Moessner at the Max Planck Institute for the Physics of Complex Systems in Germany, published the theoretical basis for how time crystals—at first considered impossible—could actually exist. Published in the journal Physics Review Letters in June 2016, the paper spurred conversations about how to build such crystals.

2.Ordinary crystals such as diamonds, quartz or ice are made up of molecules that spontaneously arrange into orderly three-dimensional patterns. The sodium and chlorine atoms in a crystal of salt, for example, are spaced at regular intervals, forming a hexagonal lattice.

2.In time crystals, however, atoms are arranged in patterns not only in space, but also in time. In addition to containing a pattern that repeats in space, time crystals contain a pattern that repeats over time. One way this could happen is that the atoms in the crystal move at a certain rate. Were a time crystal of ice to exist, all of the water molecules would vibrate at an identical frequency. What is more, the molecules would do this without any input from the outside world.

3.The concept of time crystals originated with physicist Frank Wilczek at the Massachusetts Institute of Technology. In 2012, the Nobel laureate and former Princeton faculty member was thinking about the similarities between space and

time. In physics parlance, crystals are said to "break translational symmetry in space" because the atoms assemble into rigid patterns rather than being evenly spread out, as they are in a liquid or gas. Shouldn't there also be crystals that break translational symmetry in time?

"The atoms move in time, but instead of moving in a fluid or continuous way, they move in a periodic way," Sondhi said. "It was an interesting idea." It also was an idea that led to hot debates in the physics journals about whether such crystals could exist. The initial conclusion appeared to be that they could not, at least not in the settings Wilczek visualized.

Sondhi and Khemani were thinking about a completely different problem in 2015 when they worked out the theory of how time crystals could exist. They were exploring questions about how atoms and molecules settle down, or come to equilibrium, to form phases of matter such as solids, liquids and gases.

While it was common wisdom among physicists that all systems eventually settle down, work during the last decade or so had challenged that notion, specifically among atoms at very low temperatures where the rules of quantum physics apply. It was realized that there are systems that never go to equilibrium because of a phenomenon called "many-body localization," which occurs due to the behavior of many atoms in a disordered quantum system that are influencing each other.

Work in this area is a long Princeton tradition. The first and seminal concept of how quantum systems can be localized when they are disordered, called Anderson localization, stemmed from work by Philip Anderson, a Princeton professor and Nobel laureate, in 1958. This work was extended in 2006 to systems of many atoms by then Princeton professor Boris Altshuler, postdoctoral fellow Denis Basko, and Igor Aleiner of Columbia University.

While on sabbatical at the Max Planck Institute for the Physics of Complex Systems in Germany, Sondhi and Khemani realized that these ideas about how to prevent systems from reaching equilibrium would enable the creation of time crystals. A system in equilibrium cannot be a time crystal, but non-equilibrium systems can be created by periodically poking, or "driving," a crystal by shining a

laser on its atoms. To the researchers' surprise, their calculations revealed that periodically prodding atoms that were in non-equilibrium many-body localized phases would cause the atoms to move at a rate that was twice as slow—or twice the period—as the initial rate at which they were prodded.

To explain, Sondhi compared the driving of the quantum system to squeezing periodically on a sponge. "When you release the sponge, you expect it to resume its shape. Imagine now that it only resumes its shape after every second squeeze even though you are applying the same force each time. That is what our system does," he said.

Princeton postdoctoral researcher Curt von Keyserlingk, who contributed additional theoretical work with Khemani and Sondhi, said, "We explained how the time crystal systems lock into the persistent oscillations that signify a spontaneous breaking of time translation symmetry." Additional work by researchers at Microsoft's Station Q and the University of California-Berkeley led to further understanding of time crystals.

As a result of these theoretical studies, two groups of experimenters began attempting to build time crystals in the laboratory. The Harvard-based team, which included Khemani at Harvard and von Keyserlingk at Princeton, used an experimental setup that involved creating an artificial lattice in a synthetic diamond. A different approach at the University of Maryland used a chain of charged particles called ytterbium ions. Both teams have now published the work this week in Nature.

Both systems show the emergence of time crystalline behavior, said Christopher Monroe, a physicist who led the effort at the University of Maryland. "Although any applications for this work are far in the future, these experiments help us learn something about the inner workings of this very complex quantum state," he said.

The research may eventually lead to ideas about how to protect information in quantum computers, which can be disrupted by interference by the outside world. Many-body localization can protect quantum information, according to research published in 2013 by the Princeton team of David Huse, the Cyrus Fogg Brackett

Professor of Physics, as well as Sondhi and colleagues Rahul Nandkishore, Vadim Oganesyan and Arijeet Pal. The research also sheds light on ways to protect topological phases of matter, research for which Princeton's F. Duncan Haldane, the Eugene Higgins Professor of Physics, shared the 2016 Nobel Prize in Physics.

Sondhi said that the work addresses some of the most fundamental questions about the nature of matter. "It was thought that if a system doesn't settle down and come to equilibrium, you couldn't really say that it is in a phase. It is a big deal when you can give a definition of a phase of matter when the matter is not in equilibrium," he said.

This out-of-equilibrium setting has enabled the realization of new and exciting phases of matter, according to Khemani. "The creation of time crystals has allowed us to add an entry into the catalog of possible orders in space-time, previously thought impossible," Khemani said.

The papers "Observation of discrete time-crystalline order in a disordered dipolar many-body system" and "Observation of a discrete time crystal" were published March 9 by Nature.

(Источник: https://phys.org/physics-news)

TASKS

1.What is the main idea of the text? Choose the correct answer.

a)Physicists have successfully created “time crystals” and confirmed Frank Wilczek’s hypothesis about their existence.

b)Methods of physical researchments.

c)Sponge resumes it’s shape after you release it.

2.Mark true (T) or false(F) sentences.

a)Frank Wilczek was the first who suggested that time crystals may exist in the nature. (T/F)

b)Physicists haven’t proved that translation symmetry in time could have been broken. (T/F)

c)Atoms of diamond form hexagonal structures in space. (T/F)

d)Time crystals cannot help protect information in quantum computers. (T/F)

e)Christopher Monroe was the leader of the experimental group. (T/F)

3.In what paragraphs is it written that time crystals is a potential instrument of protecting information?

1.

2.

3.

4.Put the names of paragraphs in the correct order.

1.Sci-fi device that helps to travel in time or just science term?

2.Who stands behind that.

3.The essence of the phenomenon.

a) 1 2 3

b) 3 2 1

c) 1 3 2

5. Choose the correct answer to the given question.

What were the names of Universities whose researchers have created time crystals?

a)Harvard University and University of Maryland

b)Princeton University and Harvard University

c)California Institute of Technology and MIT

6. Choose the correct translation of the given sentence.

Ordinary crystals such as diamonds, quartz or ice are made up of molecules that spontaneously arrange into orderly three-dimensional patterns.

a)Простые кристаллы, такие как алмаз, песок и лёд сделаны из частиц, случайно собираются в трехмерные шаблоны.

b)Обычные кристаллы, такие как алмаз, кварц или лёд, составлены из молекул, которые спонтанно собираются в упорядоченные трёхмерные структуры.

c)Кристаллы составлены из атомов сложенных в беспорядочные двумерные структуры.

7.Match column A and B

1.Quantum physics	a)Равновесие
2.Researcher	b)Материя
3.Matter	c)Квантовая физика
4.Equilibrium	d)Кристаллический
5.Crystalline	e)Исследователь

8.Complete the sentence.

Time crystals are materials which atoms and molecules are arranged across…

a)time and space

b)time

c)space

9. Choose the sentence with correct word order.

a) “Our work discovered the essential physics of how time crystals function” – said Shivaji Sondhi.

b) In time crystals, however, atoms are arranged in patterns not in only space, but in time also.

c) It was also an idea that led to hot debates in the physics journals about whether could such crystals exist

10.Fill in the gap with appropriate word

They also eventually may help protect information in futuristic devices known as …….. computers.

a)pattern

b)crystal

c)quantum

KEYS

Check your answers

1. a); 2. a-T, b-F, c-T, d-F, e-T; 3.- 3; 4. c); 5-. a); 6.- b)

7. 1-c;2-e;3-b;4-a;5-d; 8.- a); 9.- a); 10.-c).

Text 7. **STUDY FINDS MASSIVE ROGUE WAVES AREN'T AS RARE AS PREVIOUSLY THOUGHT**

Vocabulary

1. comprehension [kɔmprɪˈhɛnʃən] – понимание
2. rogue wave [rəug weɪv] – неконтролируемая волна
3. steep [stiːp] – крутой; высокий
4. to capture the information [ˈkæptʃə ðə ˌɪnfəˈmeɪʃən] – собирать информацию
5. to measure [ˈmɛʒə] – измерять
6. to install [ɪnˈstɔːl] – устанавливать
7. height of 49 feet [haɪt ɒv fiːt] – высотой в 49 футов
8. mean sea level [miːn siː ˈlɛvəl] – средний уровень моря
9. crest [krɛst] – гребень
10. 1.63 times [taɪms] – в 1.63 раза
11. professor emeritus [prəˈfɛsə ɪˈmɛrɪtəs] – заслуженный профессор в отставке
12. worst-case [wɜːst keɪs] – в наихудшем случае

Text

1.University of Miami Rosenstiel School of Marine and Atmospheric Science scientist Mark Donelan and his Norwegian Meteorological Institute colleague captured new information about extreme waves, as one of the steepest ever recorded passed by the North Sea Ekofisk platforms in the early morning hours of November 9 2007. Within the first hour of the day, the Andrea wave passed by a

four-point square array of ocean sensors designed by the researchers to measure the wavelength, direction, amplitude and frequency of waves at the ocean surface.
2. Using the information from the wave set—a total of 13,535 individual waves—collected by the system installed on a bridge between two offshore platforms, the researchers took the wave apart to examine how the components came together to produce such a steep wave. The data from the 100-meter wide "wall of water" moving at 40 miles per hour showed that Andrea may have reached heights greater than the recorded height of 49 feet above mean sea level. They also found that rogue waves are not rare as previously thought and occur roughly twice daily at any given location in a storm. The findings showed that the steeper the waves are, the less frequent their occurrence, which is about every three weeks at any location for the steepest rogues.
3. The Andrea crest height was 1.63 times the significant height (average height of the one third highest waves). Optimal focusing of the Andrea wave showed that the crest could have been even higher and limited by breaking at 1.7 times the significant height. This establishes the greatest height rogues can reach for any given (or forecasted) significant height. "Rogue waves are known to have caused loss of life as well as damage to ships and offshore structures," said Mark Donelan, professor emeritus of ocean sciences at the UM Rosenstiel School. "Our results, while representing the worst-case rogue wave forecast, are new knowledge important for the design and safe operations for ships and platforms at sea."
(Источник: https://phys.org/physics-news)

Tasks

1. What is the main idea of the text? Choose the correct answer.

a) The Andrea wave is the greatest rogue wave
b) Special system examined which components the rogue waves consist of
c) Scientists knew important information about rogue waves

2. Mark true (T) or false (F) sentences.

a) One of the steepest waves was recorded during the evening of November 9 2007 (T/F)

b) The Andrea's crest height was an average (T/F)

c) Scientists found that rogue waves are not rare (T/F)

d) The Andrea moved as fast as a car (T/F)

e) Researchers concluded that than frequenter the wave's occurrence is, the steeper wave is (T/F)

3. In what paragraphs is it written that the wave's characteristics are measured with the sensor array?

a) 2 b) 1 c) 3

4. Put the names of paragraphs in the correct order.

1) Rogue waves may be forecasted, too

2) Together researches

3) Non-average wave

a)1,2,3 b) 3,1,2 c) 2,3,1

5. Choose the correct answer to the given question.

Who is Mark Donelan?

a) An American emeritus professor of Marine and Atmospheric Science

b) A Norwegian researcher

c) A victim of the Andrea wave

6. Choose the correct translation of the given sentence.

Optimal focusing of the Andrea wave showed that the crest could have been even higher and limited by breaking at 1.7 times the significant height.

a) Оценка информации о волне Андреа показала, что волна могла быть ещё выше , если не была бы разбита о преграду высотой в 1,7 метра

b) Оценка информации о волне Андреа показала, что волна могла быть ещё выше , если не была ограничена в 1,7 раза

c) Волна Андреа была в 1,7 раза больше, чем все остальные волны

7. Match the words

1. Rogue	a 2) Professor
2. Emeritus	b 4) Crest
3. Square	c 5) Platforms
4. Wave's	d 1) Wave
5. Ocean	e 3) Array

8. Complete the sentence.

Researcher's results, representing the worst-case rogue wave forecast …

a) aren't new

b) cannot help to create new safe operations at seas

c) can help to create new safe operations at seas

9. Choose the sentence with correct word order.

a) The Andrea crest height 1.63 times the significant was

b) Within the first hour of the day, the Andrea wave passed by a four-point square array of ocean sensors

c) They also found that rogue waves are not rare as previously thought and occur roughly twice daily at any given location in a storm

10. Fill in the gap with appropriate word

Mark Donelan and his colleague captured new information about extreme waves, as one of … ever recorded passed by the North Sea Ekofisk platforms.

a) the steepest

b) the rarest

c) the most insignificant

KEYS

Check your answers

1. c; 2. a) F, b) F, c) T, d) T, e) F; 3.-b; 4.-c; 5. –a; 6.- b;

7. a) 2, b) 4, c) 5, d) 1, e) 3; 8.-c; 9.-b; 10.-a.

Text 8. RESEARCHERS PROPOSE TECHNIQUE FOR MEASURING WEAK OR NONEXISTENT MAGNETIC FIELDS

VOCABULARY

1.magnetic field /mægˈnetɪk fiːld/- магнитное поле

2.magnetic resonance imaging (MRI) machine -

магнитно-резонансный томограф (МРТ)

3.high-speed-storage memory -

высокоскоростные запоминающие устройства

4.semiconductor /ˌsem.i.kənˈdʌk.tər/ - полупроводник

5.computer processing unit - центральный процессор

6.magnetic moment /mægˈnetɪk ˈməʊmənt/ - магнитный момент

7.magnetic force /mægˈnetɪk fɔːs/ - сила магнитной индукции

8.dimension /ˌdaɪˈmenʃən/ - измерение,размерность

9.magnetic layer - /mægˈnetɪk leɪər/ магнитный слой

10. nitrogen-vacancy center magnetometry -

азотно-вакансионная магнитометрия

11.crystal structure /ˈkrɪstəl ˈstrʌktʃər/ - кристаллическая решётка

12.carbon /ˈkɑːbən/ - углерод

13.superconductor /ˈsuː.pə.kənˌdʌk.tər/ полупроводник

14.electron - /ɪˈlektrɒn/ электрон

15. spin - /spɪn/ - спин

Read the text and translate it into Russian.

TEXT

1.Physicists at the University of Iowa have proposed a new technique to detect and measure materials that give off weak magnetic signals or have no magnetic field at all. Their solution would use a noninvasive probe to induce a magnetic response in the material being studied and then detect how that response changes the probe's own magnetic field.The technique has many potential real-world applications, including yielding more sensitive magnetic resonance imaging (MRI) machines, developing high-speed-storage memory in the semiconducting industry, and producing more efficient computer processing units (CPUs).

2."This approach is designed to measure the situation where if you didn't have the probe nearby, you'd see nothing. There wouldn't be any magnetic fields at all," says Michael Flatté, physics and astronomy professor and senior author of the paper published in the journal Physical Review Letters. "It's only the probe itself that's causing the presence of the magnetic fields."The probe does this by creating "magnetic moments" in materials that otherwise would emit a weak magnetic field or have no magnetic field at all. Magnetic moments occur when a group of electrons orient themselves in the same direction, much like tiny compass needles all pointing, say, north. That uniform orientation creates a tiny magnetic field. Iron, for example, produces a strong response because most of its electrons get oriented in the same direction when it encounters a magnetic force.All it takes for the probe, which is just a few nanomaters in diameter, to create a magnetic moment is for two of its six electrons to snap to the same directional orientation. When that happens, the probe stimulates enough electrons in materials with weak or nonexistent magnetic fields to re-orient themselves, creating a magnetic moment in the material—or just enough of one—that the probe can detect. How the material's magnetic moment influences the probe's own magnetic field is measurable, which gives researchers the means to calculate the material's physical dimensions, such as its thickness."These electrons (in materials with weak or nonexistent magnetic fields) have their own field that acts back on the probe and distorts the probe (in a way) that you can then measure," says Flatté, director of the UI's Optical Science Technology Center.

3.This becomes important when trying to capture the dimensions of magnetic layers that are buried or sandwiched between nonmagnetic layers. Such situations arise when working with semiconductors and will increase as computer processing advances."We calculate the magnetic response, and from that we would know where the magnetic fields end and thus know the layer thickness," Flatté says.The concept builds upon an emerging sampling approach called nitrogen-vacancy center magnetometry. This technique, which relies upon an introduced defect in a diamond's crystal structure (subbing in a nitrogen atom for two carbon atoms), is effective in part because the probe it uses (like the proposed UI probe) is made of diamond, which creates small magnetic moments key to detecting magnetic fields in the studied materials.But there is a drawback: Nitrogen-vacancy center magnetometry only works with magnetized materials. That rules out superconductors, where the magnetic field ceases to exist at certain temperatures, and many other materials. Flatté and co-author Joost van Bree's proposed solution gets around that by using the probe to create a magnetic field that forces materials with weak or nonexistent magnetic fields to react to it."If you apply a magnetic field to a superconductor, it will attempt to cancel that magnetic field applied to it," Flatté says. "Even though it's doing that, it creates a magnetic field outside of itself that then affects the spin centers. That's what then can be detected."
(Источник: https://phys.org/physics-news)

TASKS

1.What is the main idea of the text? Choose the correct answer.

a) Researchers could measure weak magnetic fields

b) Researchers could understand magnetic fields

c) Researchers told that technique will be developed in a year thanks to magnetic fields

2.Mark true (T) or false(F) sentences.

a) The technique has application in developing high-speed-storage memory in the semiconducting industry (T/F)

b) Electrons get oriented in the same direction when it encounters a magnetic force (T/F)

c)The technique is helpful in creating magnets (T/F)

d)Flatté is the director of the UI's Optical Science Technology Center. (T/F)

e)Researchers told that technique will be developed in a year (T/F)

3.In what paragraphs is it written that it was a drawback in the work?

1.

2.

3.

4.Put the names of paragraphs in the correct order.

1 The news from physicists at the University of Iowa

2. Tiny magnetic fields created by electrons

3. The good solution

a) 1, 2, 3

b) 3, 2, 1

c) 2, 1, 3

5. Choose the correct answer to the given question.

What do the researchers solve the problem that nitrogen-vacancy center magnetometry only works with magnetized materials?

a) They could create a strong magnetic field that forced to the materials

b) They used the probe to create a magnetic field that forces materials with weak or nonexistent magnetic fields to react to it

c) They raised the temperature of materials so the materials could better react with magnetic fields

6. Choose the correct translation of the given sentence.

This becomes important when trying to capture the dimensions of magnetic layers that are buried or sandwiched between nonmagnetic layers.

a) Это становится важным,когда вы пытаетесь определить какой слой магнитного поля взаимодействует с немагнитными слоями материала

b) Это становится важным при попытке измерить магнитные слои,которые затухли или спрятаны между немагнитными слоями

c)Это важно,когда магнитные слои начинают взаимодействовать между собой

7.Match column A and B

1.magnetic fields	a)магнитно-резонансный томограф
2.magnetic layer	b)спин
3.spin	c)магнитный слой
4.superconductor	d)магнитные поля
5.magnetic resonance imaging machine	e)суперпроводник

8.Complete the sentence.

This approach is designed to measure the situation where if you didn't have the probe nearby,

a) you'd lose your magnetic field

b) you'd see nothing

c) you still would make the experiment

9. Choose the sentence with correct word order.

a) Magnetic moments occur when a group of electrons orient themselves in the same direction, much like tiny compass needles all pointing, say, north.

b)Magnetic moments occur when a group of electrons orient themselves in the same direction, much like tiny needles compass all pointing, say, north.

c) The moment's magnetics occur when a group of electrons orient themselves in the same direction, much like tiny compass needles all pointing, say, north.

10.Fill in the gap with appropriate word

But there is a drawback:_____ only works with magnetized materials

a) computer processing unit

b) magnetic field

c)Nitrogen-vacancy center magnetometry

KEYS

Check your answers

1)a; 2)a-T, b-T, c-F, d-T,e-F; 3)3; 4)a; 5)b; 6)b;
7)1-d;2-c;3-b;4-e;5-a; 8)b; 9)a; 10)c.

Text 9. IMAGING HIGH EXPLOSIVE DETONATORS

VOCABULARY

1. collaborator [kəˈlæb.ə.reɪ.tər] соавтор
2. snapshot [ˈsnæp.ʃɒt] моментальные снимки
3. high explosive detonators [haɪ ɪksˈpləʊsɪv ˈdetəʊneɪtə] взрывчатые вещества
4. state-of-the-art imaging capabilities [ˌsteɪtəvðiˈɑːt ɪˈmɪdʒ.ɪŋ ˌkeɪ.pəˈbɪl.ɪ.tiz] современные средства визуализации
5. computed tomographic reconstruction [kəmˈpjuːtɪd təməʊˈgræfɪk ˈriːkənsˈtrʌkʃn] компьютерная томографическая реконструкция
6. foil initiators [fɔɪl ɪˈnɪʃɪeɪtəz] детонатор с взрывающейся фольгой
7. refine [rɪˈfaɪn] уточнить
8. exploding-bridgewire detonator [ɪkˈspləʊdɪŋ brɪdʒ ˈwaɪə ˈdetəʊneɪtə] детонатор с взрывающимся мостиком
9. bridge burst [brɪdʒ bɜːst] разрыв пласта
10. surface [ˈsɜːfɪs] поверхность
11. flyer [ˈflaɪ.ər] листовка
12. shock wave [ʃɔk weɪv] ударная волна
13. aging margins [ˈeɪdʒɪŋ ˈmɑː.dʒɪn] возрастные границы
14. plasma [ˈplæzmə] плазма
15. ongoing programmatic efforts [ˈɒŋˌgəʊ.ɪŋ prɒgrəˈmætɪk ˈef.ət] потоянные программные усилия

Read the text and translate it into Russian.

TEXT

1.Lawrence Livermore National Laboratory (LLNL) scientists and collaborators at Los Alamos National Laboratory (LANL) for the first time have taken 3-D snapshots of operating high explosive detonators. Scientists from LLNL, Los Alamos and National Security Technologies, LLC (NSTech) combined state-of-the-art imaging capabilities with computed tomographic reconstruction (X-ray cross sectional imaging) in experiments performed at the Argonne National Laboratory's Advanced Photon Source to generate 3-D snapshots of exploding foil initiators.

2.Exploding foil initiators (EFI), also known as slapper detonators, offer safety and timing advantages over other means of initiating high explosives. However, understanding how detonators perform is challenging. EFI is an improvement of the earlier exploding-bridgewire detonator. Instead of directly coupling the shock wave from the exploding wire, the expanding plasma from an explosion of a metal foil drives another thin plastic or metal foil called a "flyer" or a "slapper" across a gap, and its high-velocity impact on the explosive then delivers the energy and shock needed to initiate a detonation. "The rich imaging data on EFI and flyer microstructure with time represent a new opportunity to refine the understanding of flyer operation of slapper detonators," said LLNL's Trevor Willey, a co-author of the research. "Parameters can be tuned to achieve optimal performance. The data will aid in understanding the initiation mechanism for slapper detonators."

3. The research is important for assessing aging margins, safety and performance, and in developing new and improved designs. During the experiment, a LANL/NSTech-developed four-camera system acquired four images from successive X-ray pulses from each shot. The first frame was prior to bridge burst. The second images the flyer about 0.16 millimeters (mm) above the surface, but

edges of the foil and/or flyer are still attached to the substrate. The third frame captures the flyer in flight, while the fourth shows a completely detached flyer in a position that is typically beyond where slappers strike initiating explosives. The researchers then used the recently developed Livermore Tomography Tools to reconstruct 3-D images of operating flyers.

The technique is now being used to support several ongoing programmatic efforts within LLNL. The research appears in the Journal of Applied Physics .

(Источник: https://phys.org/physics-news)

TASKS

1. What is the main idea of the text? Choose the correct answer.

a) Exploding foil initiators is better then other means of initiating high explosives.

b) LLNL managed to take snapshots of high explosive detonators.

c) It's challenging to understand how detonators perform.

2. Make true (T) or false (F) sentences.

a) Scientists from LLNL combined imaging capabilities with tomographic reconstruction.(T/F)

b) It's hard to understand how detonators work.(T/F)

c) EFI provides enough pressure to initiate a detonation.(T/F)

d) A four-camera system was developed in Los Alamos National Laboratory.(T/F)

e) The third image shows a separate flyer.(T/F)

3. In which paragraph is written that the comprehension of the process of exploding high initiators is quiet complicated?

a) 1

b) 2

c) 3

4. Put the names of paragraphs in the correct order.

1. Carrying out the research

2. First 3-D snapshots of high explosive detonators

3. Exploding foil initiators.

a) 3,2,1

b) 1,3,2

c) 3,1,2

5. Choose the correct answer to the given question.

Why exploding foil initiators has more perspectives than other means of initiating high explosives?

a) Foil initiators are easy to create.

b) Foil detonators leads to a faster explosion.

c) Its data may help to comprehend the process of explosion.

6. Choose the correct translation of the given sentence.

The rich imaging data on EFI and flyer microstructure with time represent a new opportunity to refine the understanding of flyer operation of slapper detonators.

a) Богатая информация о томографии на детонаторе с взрывающейся фольгой и микроструктуре листовки со временем представят новую возможность более детально понять процесс взрыва слэппер-детонаторов.

b) Богатая картинная информация на детонаторе с взрывающейся фольгой и микроструктуре пластины со временем представят новую возможность более детально понять процесс взрыва слэппер-детонаторов.

c) Богатая информация о томографии на детонаторе с взрывающейся фольгой и микроструктуре листовки со временем представят новую возможность управлять процессом взрыва слэппер-детонаторов.

7. Match column A and B

1.Slapper	a) reconstruction
2.Tomographic	b) initiator
3.Bridge	c) microstructure
4.Foil	d) burst
5.Flyer	e) detonator

8. Complete the sentence.

3-D snapshots of exploding foil initiators were made in…

a) Lawrence Livermore National Laboratory

b) Argonne National Laboratory's Advanced Photon Source

c) Los Alamos National Laboratory

9. Choose the sentence with correct order.

a) Four camera system, developed by scientists from LLNL, acquired from successive X-ray pulses from each shot four images.

b) Four camera system acquired four images from successive X-ray pulses from each shot developed by scientists from LLNL.

c) Four camera system, developed by scientists from LLNL, acquired four images from successive X-ray pulses from each shot.

10. Fill in the gap with appropriate word

_____ is a relatively recent kind of detonator developed in LLNL.

a) High explosive detonator

b) Exploding foil initiator

c) Exploding-bridgewire detonator

KEYS

Check your answers

1. b; 2. a-F, b-T, c-F, d-T, e-F; 3. - b; 4.- c; 5.- c; 6.- a;

7.1)e, 2)a, 3)d, 4)b, 5)c; 8.- a; 9.- c; 10.-b.

Text 10. MAGNETIC FIELDS AT THE CROSSROADS

VOCABULARY

1. vortex [ˈvôr¸teks] завихрение
2. domain [dōˈmān] домен
3. nanowire [ˈnanə¸wī(ə)r,] нанопроволока
4. ferromagnetic [¸ferō¸magˈnetik] ферромагнитный
5. magnetron [ˈmagnə¸trän] магнетрон
6. clockwise [ˈkläk¸wīz] по часовой стрелке
7. chirality [kaɪˈrælɪtiː] хиральность
8. trajectory [trəˈjektərē] траектория
9. axis [ˈaksis] ось
10. parallel [ˈparə¸lel] параллель

11. contempopary [kənˈtempəˌrerē] современный

12. quantum [ˈkwäntəm] квант

13. lithography [lɪˈθɒgrəfi|] литография

14. sputtering [ˈspʌtərɪŋ] распыление

15. spin [spin] спин

Read the text and translate it into Russian.

TEXT

1. From compasses used in ancient overseas navigation to electrical motors, sensors, and actuators in cars, magnetic materials have been a mainstay throughout human history. In addition, almost all information that exists in contemporary society is recorded in magnetic media, like hard drive disks.

A team of researchers at the Brazilian Center for Physics Research is studying the motion of vortex domain walls—local regions of charge that collectively store information via their configuration—driven by magnetic fields in ferromagnetic nanowires, which are configured in a straight line with an asymmetric Y-like branch. They discuss their work in this week's Journal of Applied Physics.

2. The question posed by the group was: What happens to the vortex wall when it meets the branch? Does it changes it direction or not, or could it be split in two walls?

"To make a simplistic parallel, if we imagine that the vortex wall is a tornado and the tornado is running on a straight road and encounters a cross-road, what happens next; can it split into two tornados?" said Luiz Sampaio, a researcher at the Brazilian Center for Physics Research in Rio De Janeiro.

Generally speaking, magnetic fields can be used to change the magnetization of a magnetic material, much like a bar magnet can magnetize an otherwise nonmagnetic sewing needle, and can even reverse its magnetization completely in some cases.

3. The process involved in magnetization reversal sometimes exhibits the nucleation and movement of these domain walls, which constitute the transition between two regions of charge magnetized in different directions. Domain wall

motion has been widely explored in ferromagnetic nanowires due to their high potential for applications in spintronic devices, those that use the quantum spin properties of electrons.

The control and manipulation of these domain walls is crucial for successful realizing magnetic memory, logic and sensors devices. By modifying the nanowire geometry, scientists hope to acquire a higher control of the domain wall motion and set a route towards achieving reliability in switching magnetization in ferromagnetic nanowires. The team devised a study using two steps.

"First, we fabricated samples using electron-beam lithography, magnetron sputtering and lift-off techniques," said Sampaio. After the nanometer-scale fabrication, they then measured the switching magnetization behavior mediated by the domain wall propagation.

The second step was to carry out micromagnetic simulations to guide and interpret the experimental results. "These two tools allowed us to study in detail the processes of vortex domain walls at the branch entrance," he said.

Moving forward, the team wants to understand whether the angle between the nanowire and branch can increase the asymmetric behavior at the branch entrance. This would increase the likelihood of observing only one type of vortex domain wall, clockwise or counterclockwise. This will require varying the nanowire angles with the branch to select the vortex chirality.

Understanding the dynamical aspects of vortex domain walls opens a route to better control of their motion and trajectory. This may be important for producing logic gates, which can be based on the domain wall motion in line with such branches. The magnetization in the branches can be oriented in two different directions along the nanowire axis, where each direction would serve as the "0" and "1" necessary for data storage and processing.

"To provide the reliability needed for these applications, a higher degree of control in the magnetization switching is required, but to enhance the efficiency of the processes involved in the magnetization switching, the vortex domain wall seems to be a promising candidate," said Sampaio.

(Источник: https://phys.org/physics-news)

TASKS

1.What is the main idea of the text? Choose the correct answer.

a) A team of researchers at the Brazilian Center for Physics Research made a fundamental discovery.

b) electron-beam lithography, magnetron sputtering and lift-off techniques were used by scientists to achieve their goals.

c) Understanding the dynamical aspects of vortex domain walls opens a route to better control of their motion and trajectory. This may be important for producing logic gates.

2.Mark true (T) or false(F) sentences.

a) Scientists fabricated samples using electron-beam lithography, magnetron sputtering and lift-off techniques (T/F)

b) They discuss their work in this week's Journal of Quantum Chemistry (T/F)

c) Domain wall motion has been widely explored in ferromagnetic nanowires (T/F)

d) Almost all information that exists in contemporary society is recorded in magnetic media (T/F)

e) vortex domain walls are local regions of charge that collectively store information via their configuration (T/F)

3.In what paragraphs is it written that magnetic fields can be used to change some properties of a magnetic material?

1.

2.

3.

4.Put the names of paragraphs in the correct order.

1. studying magnetic materials

2. vortex wall as a tornado

3. control and manipulation of the domain walls

a) 1, 2, 3

b) 3, 2, 1

c) 2,1, 3

5. Choose the correct answer to the given question.

In how many directions the magnetization in the branches can be oriented?

a) one

b) two

c)three

6. Choose the correct translation of the given sentence.

Generally speaking, magnetic fields can be used to change the magnetization of a magnetic material, much like a bar magnet can magnetize an otherwise nonmagnetic sewing needle, and can even reverse its magnetization completely in some cases.

a) в общем случае, гравитационные поля могут быть использованы чтобы изменить намагниченность магнитного материала, например как крупный магнит может намагнетизировать ненамагниченную иглу для шитья или даже полностью аннулировать ее намагниченность в некоторых случаях.

b) в общем случае, магнитные поля могут быть использованы чтобы изменить намагниченность магнитного материала, например как крупный магнит может намагнетизировать ненамагниченную иглу для шитья или даже полностью аннулировать ее намагниченность в некоторых случаях.

c) в общем случае, магнитные поля могут быть использованы чтобы изменить намагниченность магнитного материала, например как крупный магнит может намагнетизировать ненамагниченную иглу для шитья или даже полностью отобразить ее намагниченность в некоторых случаях.

7.Match column A and B

1. field	a) нуклеация
2. nucleation	b) угол
3. sample	c) немагнитный
4. angle	d) поле
5. nonmagnetic	e) образец

8.Complete the sentence.

What happens to the vortex wall when it …….?

a) meets the branch

b) changes their angle

c) disappears

9. Choose the sentence with correct word order.

a) In addition, almost all information that exists in contemporary society is recorded in magnetic media, like hard drive disks.

b) almost all information that exists in contemporary society is recorded in magnetic media, like hard drive disks, in addition.

c) like hard drive disks, almost all information that exists in contemporary society is recorded in magnetic media, in addition.

10.Fill in the gap with appropriate word

Understanding the dynamical aspects of vortex domain walls opens a route to better control of their …… and trajectory.

a) angle

b) dynamics

c) motion

KEYS

Check your answers

1)c; 2)a-T, b-F, c-T, d-T, e-T; 3)2; 4)a; 5)b; 6)c;

7) 1-d;2-a;3-e;4-b;5-c; 8)a; 9)a; 10)c.

Text 11.ULTRASHORT LIGHT PULSES FOR FAST 'LIGHTWAVE' COMPUTERS

VOCABULARY

1. nanotechnology [nӕnoʊteknɒlədʒi] нанотехнология;

2. magnetic field [mæg'netɪk fi:ld] магнитное поле;

3. challenging ['ʧælɪnʤɪŋ] стимулирующий;

4. precession [præcession] прецессировать;

5. combination [ˌkɔmbɪ'neɪʃ(ə)n] комбинация;

6. sensor ['sen(t)sə] воспринимающий датчик;

7. biological integration [ˌbaɪəu'lɔʤɪk((ə)l) ˌɪntɪ'greɪʃ(ə)n] биологическая интеграция;

8. hardware [hɑːdweə] аппаратура;

9. frequency ['friːkwən(t)sɪ] частота;

10. atom ['ætəm] атом;

11. reflect [rɪ'flekt] отражать (звук, тепло, свет);

12. measure ['meʒə] единица измерения;

13. spin [spɪn] буксовать;

14. equipment [equipment] оборудование;

15. robust [rə'bʌst] крепкая (о конструкции);

Read the text and translate it into Russian.

TEXT

1.A team of researchers at IBM has developed a new way to measure the magnetic field of individual atoms that offers 1000 times the energy resolution of conventional techniques. In their paper published in the journal Nature Nanotechnology, the team describes their approach, how well it works and their hope that they will be able to modify it in such a way as to allow others with less specialized hardware to use it.

2.Scientists are eager to better measure the magnetic fields of individual atoms because they believe it will lead to a better understanding of material and biological interactions—most particularly those involving weak magnetic interactions. Current methods rely on using defects in diamonds, though the team at IBM notes that prior work at their lab shows that it is possible to measure weak interactions in another way, an approach described as challenging. In this new

effort, the team has come up with a way to get the job done that is relatively simple, though, they note, it requires special hardware.

3.In the new approach, an atom called a sensor is placed near a target atom inside of a scanning tunneling microscope—a magnetic field is then applied to the microscope followed by a jolt of electricity to the tunnel junction. From there on, the frequency of the atom is monitored—when it matches the spin of the precession (the axis of rotation around a magnetic field that reflects its degree of magnetism), it reveals the measure of the magnetic field. The change in orientation is measured by moving the sensor atom to the microscope's sensor tip.

The researchers found their approach to be far more accurate and easier to read than other methods, pointing out that the signal they got from the technique was both stronger and more robust. They note also that few other labs likely have the combination of equipment (such as the high frequency cabling added to the microscope) required to replicate their technique, so they plan to continue the work in hopes of achieving the same results under more relaxed conditions.

(Источник: https://phys.org/physics-news)

TASKS

1.What is the main idea of the text? Choose the correct answer.

a) New microscope technique offers a better way to measure magnetic field of individual atoms

b) IBM researchers create world's smallest magnet

c) The world's first commercial "universal" quantum-computing service.

2.Mark true (T) or false(F) sentences.

a) Scientists are eager to better measure the magnetic fields (T/F)

b) In the new approach, an atom called a sensor is placed near a target atom inside of electricity (T/F)

c) The researchers found their approach, a magnetic field is then applied to the microscope followed by a jolt of electricity to the tunnel junction. (T/F)

d) Current methods rely on using defects in diamonds, it reveals the measure of the magnetic field. (T/F)

e) A team of researchers at IBM has developed a new way to measure the magnetic field (T/F)

3.In what paragraphs is it written that a scanning tunneling microscope a magnetic field is then applied to the microscope followed by a jolt of electricity to the tunnel junction?

1.

2.

3.

4.Put the names of paragraphs in the correct order.

1. A team of researchers

2. A new atoms measure

3. A new inside view to atom

a) 1, 3, 2

b) 3, 2, 1

c) 2, 1, 3

5. Choose the correct answer to the given question.

Where is placed an atom called a sensor?

a) near a target atom inside of a scanning tunneling microscope;

b) near electricity to the tunnel junction;

c) near a magnetic field, when it is jolt;

6. Choose the correct translation of the given sentence.

In the new approach, an atom called a sensor is placed near a target atom inside of a scanning tunneling microscope

a) В современном подходе, атомы чувствительного датчика расположены близко к мишени, внутри сканирующего туннельного микроскопа.

b) В новом подходе, чувствительные атомы расположены, близко к туннельно сканирующего микроскопа.

c) В новом подходе, атом называемый датчиком располагаются около мишени атома, внутри сканирующего туннельного микроскопа.

7.Match column A and B

1. magnetism;	a) открытия;
2. prior;	b) прежний;
3. approach;	c) поле;
4. field;	d) магнетизм;
5. reveals;	e) подход;

8.Complete the sentence.

Scientists are eager to better measure the magnetic fields of individual atoms because they believe it will lead to a better understanding of material and biological interactions……

a) a magnetic field is then applied to the microscope followed by a jolt of electricity to the tunnel junction

b) most particularly those involving weak magnetic interactions

c) when it matches the spin of the precession, it reveals the measure of the magnetic field

9. Choose the sentence with correct word order.

a) Current methods rely on using defects in diamonds, though the team at IBM notes that prior work at their lab shows that it is possible to measure weak interactions in another way, an approach described as challenging.

b) Though the team at IBM, current methods rely on using defects in diamonds, that it is possible to measure weak interactions in another way notes that prior work at their lab shows, an approach described as challenging.

c) An approach described as challenging. Current methods lab shows that it is possible to measure weak interactions in another way. Rely on using defects in diamonds, though the team at IBM notes that prior work at their method.

10.Fill in the gap with appropriate word

The change in …… is measured by moving the sensor atom to the microscope's sensor tip.

a)orientation

b)equipment

c)technique

KEYS

Check your answers

1)a; 2) a-T, b-F, c-F, d-F, e-T; 3)3; 4)a; 5)a; 6)c; 7) 1-d;2-b;3-e;4-c;5-a;
8)b; 9)a; 10)a.

Appendix

GLOSSARY

absolute zero

Temperature at which gases cease to exert pressure;
0 K, or -273°C

acceleration

Rate of change of velocity, or the change in velocity divided by the time it takes for the change to occur

alternating current (AC)

Type of current that naturally results from the continued turning of a coil (e.g., an electromagnet) in a fixed magnetic field; the type of current in your house

alloy

Solid mixture containing two or more metals, or a metal and other elements
amplifier. An electronic device used to increase the strength of the signal fed into it

ammeter

Instrument for measuring the flow of electricity

ampere (amp)

Rate of flow equal to one coulomb of electric charge per second

amplitude

"Height" of a wave, measured as a displacement from a zero level

atom

Once thought to be the smallest component of matter; now thought to be simply the smallest unit of an element cathode ray tube (CRT) A vacuum tube containing one or more electron guns, and a phosphorescent screen used to view images

capacitance

Rating, stated in ohms, of the ability of a nonconductor (dielectric) to store charge when there is a difference in potential between its opposite surfaces

Celsius scale

System of temperature measurement in which the ice point is designated as 0° and the steam point as 100°; formerly called centigrade system

charge

Property of matter that is a measure of its excess or deficit of electrons

chemical potential energy

Energy stored in chemical bonds

compound

Substance that is the combination of two or more elements

conduction

Transfer of molecular motion through a substance by collisions; one way in which heat passes from one material to another

conductor

Material that allows electric charge to pass freely, with little resistance

coulomb

SI unit of electric charge; equal to the quantity of electricity moved by a current of 1 A in 1 s

degree

Unit for measuring temperature on various scales

direct current (DC)

Type of current in which the charge flows continually in one direction; the type of current in handheld electronics

electric circuit

Complete path of an electric current, including a source of potential difference and usually including various components (e.g., resistors, diodes)

electric current

Charge in motion

electric field

Space in the vicinity of a charged object in which its force or some part of it is exerted

electric force

Attractive or repulsive force between two charged objects (the Coulomb force)

electric resistance

Opposition of a conductor to the passage of electric V current

electricity

Electric current or power; the study of charges in motion

electromagnet

Device for increasing electromagnetic force by means of a soft-iron core

electromagnetic force

Combination of magnetic and electric forces, due to the motion of charged particles

electromagnetic induction

Production of electric current by means of a coil and a magnet

electromagnetic waves

Any waves that result from the motion of charged particles

electromotive force (emf)

A potential difference that causes electric charges to flow

electron

Smallest indivisible particle with negative charge

electrostatic induction

Production of an electric charge in a neutral body by bringing it near a charged one

electrostatics

Study of charges that are not in motion

element

Chemical that cannot be further broken down into component chemicals

emission lines

Bright spectral lines emitted by excited atoms with or without a continuous spectrum as a result of electronic transitions

energy

Ability to do work

field lines

Lines indicating the direction of a force field

force

Push or pull exerted on or by an object

free fall

State of an object under the influence of a gravitational force with no counteracting force

frequency

Number of vibrations per second of a wave; the reciprocal of period

fundamental units

Units of measurement that are the basis of our measurement of the universe; the meter (length) and second (time) are examples of fundamental units

galvanometer

Coil of wire that is free to rotate in a magnetic field; can be used to measure voltage or current

generator

Device used to convert mechanical energy into electrical current

gravitational potential energy

Energy associated with position in a gravitational field, or the amount of work an object can perform by returning to its original position

gravity

Attractive force between objects with mass; the curvature of space-time induced by the presence of mass

grounding

Loss of charge that occurs when a charged object is connected to a very large body with an almost infinite capacity to provide or absorb electrons

heat

Thermal energy that can be transferred between two bodies at different temperatures

hertz (Hz)

Unit of frequency; 1 Hz equals 1 cycle per second integrated circuit (IC), (chip) A small electronic device made out of a semiconductor material

insulator

Nonconductor; material that impedes passage of electric charge

kelvin

Temperature increment of the Kelvin, or absolute, scale of temperature; formerly called degree Kelvin

Kelvin scale

Temperature scale based on absolute zero (-273°C), also called absolute scale

kinetic energy (KE)

Energy of a moving body

liquid

State of matter in which the matter has no shape of its own but takes the shape of its container

magnetic field

Region around a magnet in which its effects are exerted

magnetic induction

Temporary transference of magnetism from a permanent magnet to another material

magnetic poles

The two ends of a magnet, north and south

magnetism

Ability to attract iron and certain other metals with a similar molecular structure

mass

Amount of matter an object or substance contains

matter

In classical physics, anything that takes up space; in modern physics, matter and energy are interchangeable

mechanical energy

Amount of work an object (body) can do

meter

Fundamental unit of length, about 39.37 in.

metric system

System of measurement in which all fundamental units are multiples of 10

molecule

Stable combination of two or more atoms

oscillate

Move back and forth about a center; vibrate

oscilloscope electronic test instrument that allows observation of constantly varying signal voltages on a screen in a two dimensional format

parallel circuit

Connection of electrical components in such a way that current can branch in multiple directions, one through each component in parallel

period

Time required to complete one cycle of a wave; the reciprocal of frequency.

physics

Study of matter, energy, and the laws governing their interactions

potential difference

Difference in electric charge between two objects; a charge will tend to move from the area of higher potential to the area of lower potential

power

Rate of doing work

pressure

Amount of force exerted by an object on the area of the surface on which it acts

resistance

Capacity of an object or material to impede motion; also, the capacity of a material to impede the motion of charge

resonance

Process by which sound vibrations build up

scalar

Measured quantity that has size but no direction; mass is a scalar quantity

second

Basic unit of time in both the English and the metric systems

semiconductor

Solid-state device having medium resistivity used to transmit and amplify electronic signals

series circuit

Connection of electrical components in such a way that the same current flows through each component

solenoid

Coil of wire that can carry current; used in transformers

solid

State of matter that has a definite shape and volume

speed

Rate at which something moves

static electricity

Electric charge resting on an object

superconductor

Substance that at low temperature has almost no resistance to the passage of current

temperature

Degree of hotness or coldness of an object or an environment; a measure of the average velocity of particles in a substance

time

Continuum along which events move from the past through the present and into the future; not an absolute according to special relativity

transformer

Device that changes voltage and current values in AC circuits

transistor Devices that switch electric currents on and off or amplify electric currents

vacuum

Space devoid of matter

vector

Measured quantity that has both a magnitude and a direction; weight, for example, is a vector quantity

velocity

Speed measured in a particular direction (a vector quantity)

volt

Measure of potential difference equal to 1 J/C

voltmeter

Instrument for measuring voltage that passes current through a rectangular coil having a high resistance

watt

Measurement of power; working rate of 1 J/s

weight

The pull of Earth's gravity on an object

work

Transfer of energy to an object by the application of a force over some distance

BIBLIOGRAPHY

1. Багаутдинова Г.А., Лукина И.И. Английский язык для аспирантов и соискателей: [Электронный ресурс]: учеб. пособие / Г.А. Багаутдинова, И.И. Лукина. - Казань: Казан. ун-т, 2012. - 134с. //http://kpfu.ru/main_page?p_sub=7108
2. Баранова А.Р., Маршева Т.В., Переточкина С.М. English for Radiophysics and Electronics [Электронный ресурс] / А.Р.Баранова,Т.В.Маршева, С.М.Переточкинаова - Казань: Казан. ун-т, 2015. http://edu.kpfu.ru/enrol/index.php?id=1364
3. Курашвили Е.И., Кондратьева И.И., Штрунова В.С.. Английский язык для студентов-физиков. Второй этап обучения : учеб. пособие 2-е изд., перераб. и доп. — М.: Астрель: АСТ, 2005. – 189 с.
4. Луговая А. Л. Английский язык для студентов энергетических специальностей: учеб. пособие. – М: Высш. шк., 2009. – 152 с.
5. Радовель В.А. Английский язык для технических вузов: Учебное пособие. – М: «Дашков и К», 2010. – 444 с.
6. Махмутова А.Н. Master English for Mathematics, Engineering and Computing Sciences [Электронный ресурс] / А.Н. Махмутова - Казань: Казан. ун-т, 2016. http://edu.kpfu.ru/course/view.php?id=872
7. Радовель В.А. Английский язык. Основы компьютерной грамотности: Учебное пособие. – Изд. 3-е – Ростов н/Д: Феникс, 2006. – 224с.
8. Поленова А. Ю. Числова А. С. A Complete Guide to Modern Writing Forms. Современные форматы письма в английском языке. - М.: ИНФРА-М: Академцентр, 2012. - 160с. //http://znanium.com/bookread.php?book=235606
9. Сайфуллина М.З., Баранова Ф.Р., Маршева Т.В., Шамсутдинова Э.Х. Иностранный (английский) язык для физико-математического направления и информационных технологий [Электронный ресурс] /

М.З.Сайфуллина, А.Р.Баранова, Т.В.Маршева, Э.Х. Шамсутдинова - Казань: Казан. ун-т, 2016. http://edu.kpfu.ru/enrol/index.php?id=1749

10. Сиполс, О. В. Develop Your Reading Skills: Comprehension and Translation Practice. Обучение чтению и переводу (английский язык) [Электронный ресурс]: учеб. пособие / О. В. Сиполс. - М.: Флинта: Наука, 2011. - 376 с. http://znanium.com/bookread.php?book=409896
11. Сайфуллина М.З., Баранова Ф.Р., Маршева Т.В., Шамсутдинова Э.Х. Иностранный (английский) язык для физико-математического направления и информационных технологий [Электронный ресурс] / М.З.Сайфуллина, А.Р.Баранова, Т.В.Маршева, Э.Х. Шамсутдинова - Казань: Казан. ун-т, 2016. http://edu.kpfu.ru/enrol/index.php?id=1749
12. Christopher G. De Pree, Ph.D. Physics Made Simple – by Broadway Books, a division of Random House, Inc., 2004. – 197 p.
13. http://study.com/academy/lesson
14. http://www.radio-electronics.com
15. http://www.ab4oj.com
16. http://electronics.howstuffworks.com
17. http://www.wordreference.com
18. http://ethw.org/Transistors
19. https://phys.org/physics-news/