NATO Science for Peace and Security Series B: Physics and Biophysics 2011, pages 381-389

Yttrium nanoparticle hydrogen gas sensors

Stepanov A., Reinhodt A., Kreibig U.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The preparation of new types of nanosystems based on metallic yttrium nanoparticles, which are difficult to produce by traditional methods due to the high melting temperature and the extremely high oxidizability of this metal, has been studied. The materials were prepared with an original high vacuum set-up (LUCAS) intended for the formation of metal nanoparticle beams by laser ablation. Yttrium nanoparticles were synthesized, and their chemical reactions with hydrogen were studied at room temperature. It was found that the reaction at low hydrogen pressures (~10 -3 Pa) leads to the formation of YH 2 dihydride particles with metallic properties and optical plasmon absorption. An increase in the hydrogen pressure to ~100 Pa results in the transformation of metallic-like YH 2 nanoparticles to dielectric YH 3-x (x<1) nanoparticles. It is shown that the last reaction corresponding to the metal-dielectric phase transition is reversible with respect to the hydrogen pressure. These experimental data demonstrate that yttrium nanoparticle materials can be effectively used as optical hydrogen gas sensors.

http://dx.doi.org/10.1007/978-94-007-0903-4-39

Keywords

Hydrogen gas sensor, Laser ablation, Plasmon resonances, Yttrium dihydride, Yttrium-based nanoparticles