

A homebuilt ESE spectrometer on the basis of a high-power Q-band microwave bridge

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Abstract

We present a Q-band spectrometer which was built recently at the Institute of Physical Chemistry of the University of Stuttgart. It allows us to perform the field-sweep electron spin echo (ESE), pulsed electron-nuclear double resonance (ENDOR), relaxation and electron spin echo envelope modulation experiments both at room and low (down to 1.5 K) temperatures. The spectrometer consists of an electromagnet, digital field controller, pulsed microwave bridge, probehead, cryostat, radio frequency unit, pulse programmer and data acquisition electronics. The Q-band microwave bridge with 10.8 W output power is based on a two-stage IMPATT-diode pulse amplifier. The commercial Varian electromagnet system is controlled by a 24-bit homebuilt digital controller. The external devices are interfaced to the two PCs via GPIB and LAN. The spectrometer control software was developed in Visual C++. It consists of two programs running synchronously on the control PCs. The spectrometer is equipped with a cylindrical TE 011 cavity constructed both for ESE and for pulsed ENDOR. The cavity fits into a liquid He cryostat thus allowing low-temperature experiments. An 8-bit data acquisition digitizer is used to collect the echo signals, and the PBESR-PRO-400 digital word generator orchestrates the pulse experiments and sets pulse sequences of the microwave bridge. The spectrometer performance is demonstrated on nitrogen impurities in a polycrystalline synthetic diamond, on silver clusters supported on NaA zeolite and electron-irradiated tooth enamel. © 2008 Springer-Verlag.

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