Master thesis abstract

Fiber-optic detection of electron spin resonance in diamond microparticles with nitrogen-vacancy defects

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The work is devoted to the creation of an opto-microwaveguide interface for the optical detection of electron spin resonance in diamond particles with defects of the nitrogen-vacancy type, which underlies many protocols of quantum sensorics. The created tool is designed to bypass the limitation of the standard method of working with NV-centers, based on confocal microscopy. A compact and flexible probe was developed for various applications of NV centers, in particular for measuring the temperature in living free-moving animals.

To optimize the created tool, estimates were made of the degree of localization of optical conjugation of a diamond particle with different classes of optical fibers. Various configurations of integrated microwave delivery systems are proposed, as well as experimental methods for their production. An optical-waveguide probe was manufactured by etching the conducting structure. The length of the manufactured probe is 20 cm, the diameter is 270 μm. Measurements of the distribution of the microwave field around an optical-waveguide probe with a high spatial resolution provided by an auxiliary fiber-optic probe-meter integrated with a diamond sensor measuring 50x15 μm are measured. The subwavelength localization of the microwave field around the optical-waveguide probe within 400 μm is demonstrated, and it is also experimentally shown that it is possible to control the efficiency of the delivery of microwave radiation to the particle by changing the configuration of the microwave transmission line. The possibility of measuring temperature in living animals with an accuracy of 0.1 K using the designed opto-microwave probe was demonstrated.