ESR investigations of Y_2SiO_5: Nd^{3+} as a material for the optical quantum memory

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In the frame of this work we investigate new materials for optical quantum memory such as isotopically pure dielectric crystals activated by rare earth ions. Monoisotopic composition of the impurity ions will enable one to achieve high optical density of the resonance medium with a minimum concentration of undesirable impurities. At the same time, the isotopic purity of the crystal matrix will reduce both inhomogeneous broadening of the resonance transitions of impurity ions, which are important for implementing of various protocols of quantum information processing, and homogeneous broadening, which is of most importance for quantum memory. The actuality of the study is connected with the fact that the impurity crystals activated with rare-earth ions are currently considered as the most promising carriers of quantum information.

Study of materials by means of EPR and NMR at cryogenic temperatures are suitable for the determination of effective spin Hamiltonian parameters of the ground and excited states, which are crucial for the realization of Raman optical quantum memory and frequency conversion of photons between optical and GHz ranges.

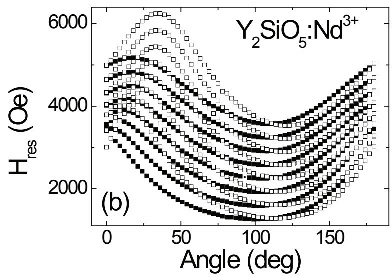

Figure 1. Angular dependences of the ESR resonance fields of the Nd^{3+} ions in Y_2SiO_5 at T=5K.

We studied Y_2SiO_5 doping with $^{143}Nd^{3+}$ ions by electron paramagnetic resonance method at 5K. The EPR spectra of Y_2SiO_5:Nd^{3+} consist of two groups of lines. Each group contains eight lines that can be attributed to the hyperfine structure of Nd^{3+} ion (S=1/2, I=7/2).

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