Magneto-Optical Modulation of Signals Using Colloidal Strontium Hexaferrite Nanoplatelets

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Herein we report on the synthesis and properties of stable ferrofluids based on hard magnetic plate-like strontium hexaferrite nanoparticles. Applying even of a weak magnetic field to colloids of suchlike particles forces them to align coherently along the magnetic field lines, and thus change the optical density of the colloid, which is easily visible even to the naked eye. This is called a magneto-optical response. The goal of this project is to obtain and study magnetic fluids with a high-frequency magneto-optical response. Stable aqueous colloids with strontium hexaferrite platelet nanoparticles (mean diameter of 50 nm and thickness of 5 nm) were obtained using glass-ceramics method. Magnetic measurements have shown that the particles are ferromagnetic. The presence of a large remanent magnetization and coercivity indicates the presence of an intrinsic magnetic moment of the particles. We have studied the magneto-optical response of ferrofluids in alternating magnetic fields using a self-made device. The study revealed very fast colloidal magneto-optical response rate, which exceeds 5 kHz while using additional permanent magnetic field, which enhances the response. Moreover, we showed that applying the rotating magnetic field was the best-case scenario for studying the colloidal particles dynamics since it allowed to get the strongest response without introducing any kind of distortion into the modulated signal. In addition, using the magneto-optical response of the ferrofluid the modulation and different kinds of distortions of the musical audio signal by colloidal medium were demonstrated.

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