Tunable Optical Grating in Magnetic Nanofluid

Urveshkumar Soni[a], Rucha P Desai[a]

[a] *P. D. Patel Institute of Applied Sciences, Charotar University of Science and Technology (CHARUSAT), CHARUSAT Campus, Changa, 388421, Gujarat, India.*

Magnetic nanofluid is a novel material with optical properties. Due to the structure's controllability, the material's magneto-optical properties can be modified. The study examines the magnetic nanofluid's microstructural characteristics and calculates the diffraction angle as a function of time. The tunable refractive index, microscopy, magnetic, and other properties of the magnetic nanofluid are examined as a function of the concentration of silica nanoparticles and the external magnetic field. The study demonstrates that the addition of silica nanoparticles to the pure magnetic nanofluid enhances the magnetic field-induced refractive index and microstructure development. The recorded microscopic photographs were analyzed using ImageJ software (figure 1(a) & (b)), which revealed that the magnetic chains in F80 are short, thin, and scattered, but the magnetic chains in F80T20, F75T25, and F70T30 are long, thick, and concentrated. Using colloidal silica nanoparticles, magnetic field-assisted microstructures can be controlled in the magnetic nanofluid. The magnetic microstructures behave like grating and the calculated diffraction angle in the pure and silica-mediated magnetic nanofluid for a specified period. The diffraction angle for each fluid sample was obtained using the successive distance between magnetic microstructures. The maximum variation in the diffraction angle occurs at around 16 degrees after 5 minutes of applying a steady magnetic field to the silica-mediated magnetic nanofluid F70T30 (figure 1(c)). Magnetic interaction energy for pure and silica-mediated magnetic nanofluids is consistent with magnetic and optical experimental results. This innovative tunable optical grating is low in cost, compact in size, highly controllable, and simple to fabricate.

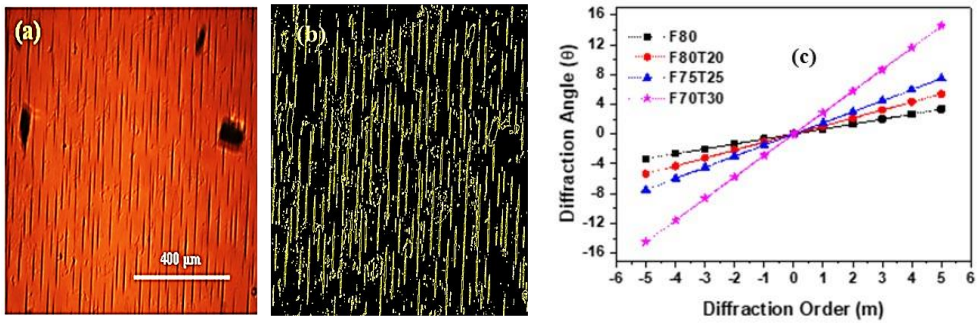

Figure 1: (a) Microscopic image of magnetic field-induced chain formation, (b) Analyzed microscopic image using ImageJ/Fiji software, and (c) Tunable diffraction angle after 5 minutes in pure and silica mediated magnetic fluids

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