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Real-time tunable microparticle diffraction based on magnetics
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— Photonic crystals and diffraction gratings are key components in color displays, bio/chemical sensors and security coded documentation, among others. Most magnetically responsive photonic crystals rely on electrostatic repulsion and magnetic attraction between constituent particles to tune the inter-particle spacing and thus, their resulting optical signatures. We present a 2D tunable diffraction device based on an all magnetic confinement and manipulation scheme previously developed for fluid borne magnetic dipoles (Scientific Reports 3, 3124 (2013)). The confinement platform consists of thin-film permalloy shapes patterned on a silicon surface and a precessing magnetic field. By adjusting the orientation of the field, inter-particle dipolar and trap confinement forces are tuned, thereby enabling the confined magnetic beads to repel or attract one another. A bench top epi-illumination microscope delivers a narrow incident light cone that is diffracted and subsequently imaged. We investigate the white light diffraction from beads in various overall confining potentials, as a function of the orientation of the magnetic field. The presence of the confining potential and field-tunable inter-particle spacing gives rise to a wide range of tunable diffraction patterns.

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