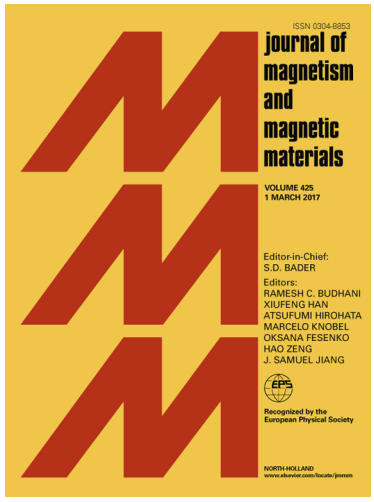

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Influence of Anisotropic Dipolar Interaction on the Spin Dynamics of $Ni_{80}Fe_{20}$ Nanodot Arrays Arranged in Honeycomb and Octagonal Lattices

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Abstract

Ultrafast spin dynamics in ferromagnetic nanodot arrays with dot diameter 100 nm and thickness 20 nm arranged in honeycomb and octagonal lattice symmetries are studied to explore the tunability of the collective magnetization dynamics. By varying the inter-dot separation between 30 nm to 300 nm drastic variation in the precessional dynamics from strongly collective to completely isolated regime has been observed by using all-optical time-resolved magneto-optical Kerr microscope. Micromagnetic simulation is exploited to gain insights about the resonant mode profiles and magnetic coupling between the nanodots. A significant spectral and spatial variation in the resonant mode with increasing dipolar interaction is demonstrated with increasing inter-dot separation. The spins driven by effective field inside single nanodots are prone to precess independently, generating two self-standing centre and edge modes in the array that are influenced by the relative orientation between the inter-dot coupling direction and bias magnetic field. The anisotropic behavior of dipolar field is rigorously investigated here. Splitting of the centre mode in case of octagonal lattice is experimentally observed here as a consequence of the anisotropic dipolar field between the nanodot pairs coupled horizontally and vertically, which is not found in the honeycomb lattice. In addition, proper understanding of the modification of dynamic mode profile by neighboring dipolar interaction built up here, is imperative for further control of the dynamic dipolar interaction and the corresponding collective excitation in magnonic crystals. The usage of nanodot lattices with complex basis structures can be advantageous for the designing of high density magnetic recording media, spin-wave filter and logic devices.