Dansk Fysisk Selskab

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Simulated Dynamics and Clustering of Colloidal Magnetic Nanoparticles

A promising bottom-up method for fabricating novel devices and structures is by magnetically guided self-assembly. To this end, precise models of magnetic particle interaction, in particular dipole-induced clustering and the properties of the aggregate structures, are necessary. We present a model of magnetic nanoparticle (MNP) interactions, implemented with a molecular dynamics algorithm, which simulates the time evolution and aggregation of colloidally suspended MNPs. Through small scale simulations, visualised with 3D animations, we give an overview of the mechanisms by which different cluster types form. We recognise three distinct clustering regimes : dissociated, linear and clustered. Based on large scale simulations, we link the appearance of these regimes to the radii of the MNPs magnetic layer and surfactant layer.

Primary authors: Mr DURHUUS, Frederik (Technical University of Denmark); Mr WANDALL, Lau (Technical University of Denmark); Mr BOISEN, Mathias (Technical University of Denmark)

Co-authors: Prof. FRANDSEN, Cathrine (Technical University of Denmark); Mr BELEGGIA, Marco (Technical University of Denmark)

Presenters: Mr DURHUUS, Frederik (Technical University of Denmark); Mr WANDALL, Lau (Technical University of Denmark); Mr BOISEN, Mathias (Technical University of Denmark)