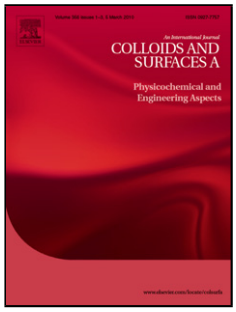

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Dependence of the regime change in particle aggregates on the composition ratio of magnetic cubic particles with different magnetic moment directions

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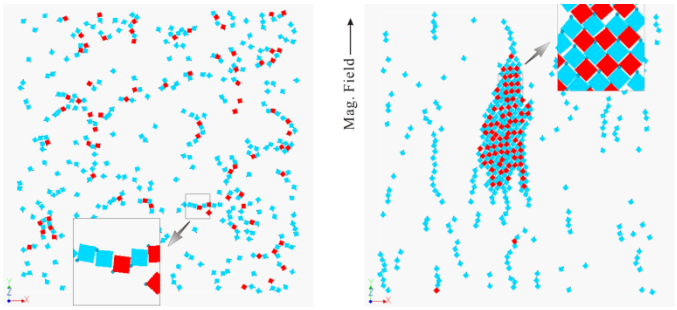
GRAPHICAL ABSTRACT



HIGHLIGHTS

► The Influence of magnetic moment directions has been verified.
► The combination of the particles with upward and downward directions gives rise to large stable aggregates.
► Decrease in the composition ratio of particles with different directions induces smaller clusters.
► The Influence of a variety of factors such as magnetic interactions on the aggregates has been clarified.

ABSTRACT

We here discuss the behaviour of a suspension composed of magnetic cubic particles on a material surface in order to apply the characteristics of a magnetic cubic particle suspension to the development of surface modification technology. A magnetic field is assumed to be applied in a direction parallel to the material surface and the cubic hematite particles are assumed to have a magnetic moment in the diagonal direction of the particle. Moreover, in the situation of a strong gravitational field, the cubic particles are assumed to be bound on the material surface with a face of each cubic particle in contact with the material or bottom surface plane. In a previous study we concentrated on the situation where half the ensemble particles have a magnetic moment pointing in the upward diagonal direction and the others in the downward diagonal direction relative to the material surface. We here expand the previous study to a variety of ensembles described by a ratio of the number of the magnetic moments aligning in these two directions. From quasi-2D Monte Carlo simulations, it is seen that the composition ratio of these cubic particles has a significant effect on the regime of the particle aggregates. That is, with decreasing composition ratio, the size of closely-packed aggregates becomes smaller, and thin linear clusters tend to be preferred in the situation of a strong magnetic field. Furthermore, a decrease in the composition ratio tends to dull the occurrence of regime change in particle aggregates for a change in the magnetic particle-particle interaction strength.

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