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Characteristics of agglomeration dynamics of ferrofluid under magnetic field: Effects of temperature and sample container shape

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We have studied the agglomeration dynamics of magnetite ferrofluid under the magnetic field by measuring the temporal change of the magnetic weight. As the magnetic nanoparticles agglomerate at the bottom of the sample container by magnetic field, the magnetic weight increases by the stretched exponential, $m(t) = m(\infty) + [m(0) - m(\infty)] \exp[-(t/\tau)^{\beta}]$ where $0<\beta<1$. The stretched exponential dynamics is observed when the activation energy involved in the dynamics is not a single value but has some distribution. The distribution function of the activation energy can be determined by the inverse Laplace transformation of the time dependence of the dynamics if the pre-exponential factor of the rate constant is known. The dynamics of the magnetic weight change is observed to be sensitive to the temperature, which is explained well as thermodynamic effects. The magnetic weight decreases with the temperature rise because the structure of the agglomerate is perturbed by thermal motions of the constituent nanoparticles. The agglomeration dynamics varies depending on the shape of the sample container. Analysis of the dynamics indicates that the distribution function of the activation energy makes blue shift and becomes broader during the agglomeration. The sample in a conical container shows the much more significant change of the distribution function than that in a container with flat bottom.

Biography

Hackjin Kim has completed his PhD from the University of Illinois and joined the Chungnam National University after Post-doctoral studies at the Stanford University. He has interests in the study of the dynamics of various condensed phases.

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