Microstructure of particulate aggregates in colloidal suspension of carbon nano-particles

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Abstract

We investigate microstructure of colloidal aggregates using fractal concept and its relations with macroscopic properties of colloidal suspension consisting of carbon nano-particles and ethylene glycol. The microstructure is characterized by fractal dimension [1-3] and the macroscopic properties such as sedimentation velocity and shear viscosity are measured. Scaling approach is used to determine relation between the macroscopic properties and the fractal dimension. We employ two kinds of macroscopic properties which are average sedimentation velocity and viscosity behavior such as yield stress and intrinsic viscosity obtained from viscosity as a function of particle concentration. First, scaling relation between sedimentation velocity and fractal dimension [4,5] is developed. Sedimentation velocity data are obtained for volumetric particle concentrations of 0.01-0.05. The fractal dimension is estimated to be around 2.2 from the sedimentation velocity. Secondly, we use intrinsic viscosity and yield stress, respectively, to determine the fractal dimension [6-9]. The fractal dimension from intrinsic viscosity is in excellent agreement with that from yields stress. However it is found that the fractal dimension obtained from viscosity behavior is lower than that from sedimentation velocity. This discrepancy can be attributed to cluster restructuring during relatively long-time sedimentation process.

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