

Aggregation of Fractal Aggregates Inside Fractal Cages in Irreversible Diffusion Limited Cluster Aggregation Binary Systems

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Abstract : Irreversible diffusion-limited cluster aggregation (DLCA) of binary sticky spheres was simulated by modifying the Brownian Cluster Dynamics (BCD). We randomly distribute N spheres in a 3D box of size L , the volume fraction is given by $\Phi_{\text{tot}} = (\pi/6)N/L^3$. We identify N_A and N_B number of spheres as species A and B in our system both having identical size. In these systems, both A and B particles undergo Brownian motion. Irreversible bond formation happens only between intra-species particles and inter-species interact only through hard-core repulsions. As we perform simulation using BCD we start to observe binary gels. In our study, we have observed that species B always percolate (cluster size equal to L) as expected for the monomeric case and species A does not percolate below a critical ratio which is different for different volume fractions. We will also show that the accessible volume of the system increases when compared to the monomeric case, which means that species A is aggregating inside the cage created by B. We have also observed that for moderate Φ_{tot} the system undergoes a transition from flocculation region to percolation region indicated by the change in fractal dimension from 1.8 to 2.5. For smaller ratio of A, it stays in the flocculation regime even though B have already crossed over to the percolation regime. Thus, we observe two fractal dimension in the same system.

Keywords : BCD, fractals, percolation, sticky spheres

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