Structure & dynamics of fractal-like particles made by agglomeration and sintering

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Abstract

The growth of silica nanoparticles by agglomeration and viscous flow sintering is studied from free molecular to transition regime at high temperatures by discrete element method simulations. The effect of temperature on the aggregate mobility and gyration radii, particle morphology and collision frequency function is elucidated as function of the number of primary particles. The ratio between the characteristic sintering time and characteristic collision time controls the particle size and structure, quantified by the mass fractal dimension. The effect of this ratio of characteristic times on aggregate morphology is illustrated at various temperatures. Finally, when sintering is negligible, the overall collision frequency is 90% larger than that predicted by the classic Fuchs collision kernel for monodisperse agglomerates in the near free molecular and transition regime. For comparable coagulation and sintering rates, where aggregates with sinter bonds are formed, the overall collision frequency increases an enhancement of <90% is observed.

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