Surface modification, colloidal interaction and the motion of particles

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A large portion of the goods transported on earth is transported as granulates and powders. With the advances in production techniques of composite materials, the grain size of these powders tends to shrink and reach sizes in the micron and even sub-micron range. For a good processability of the powders their flow behavior is a dominant parameter. The smaller the particles become, the more dominant is the influence of the inter-particle forces on this flow behavior. The macroscopic behavior of such particulate systems is a complex interplay between the internal properties of the particles, their surface properties and the structure the particles form. In this presentation I will focus on the effect of the particle surface and its modification.

I will discuss the influence of surface modification and particle interaction on the mobility of the particles on various length scales. By choosing the appropriate particle chemistry, the interaction between the particles can be tuned from attractive and strongly binding to almost purely repulsive. The structure and mechanical properties of the particle system result from a complex interplay between the particle interaction and the deformation history of the sample. Using mechanical testing and 3D structural analysis of the sample, correlations between particles interaction and the flowability become visible.

In case the particles are in contact with more than one liquid, the wetting behavior (and thus the surface properties of the particles) plays the dominant role in the particle interaction. The surface energy of the particles can be tuned through the density of hydrophobic groups on a otherwise hydrophilic surfaces. When the interfacial energies allow a finite contact angle of the liquid interface on the particles. The wetting dynamics governs the microscopic as well as the macroscopic dynamics of the system.

Selected reference:

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