Applications of Atomic Force Microscopy in Particle Technology

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Atomic force microscopy (AFM) with its manifold scanning modes and especially with the colloidal probe mode allow the direct measurement of particle interactions and surface geometry. Thus, it is the direct way to evaluate the adhesion of particles to surfaces or to each other. With the direct measurement, it is significantly easier to quantify the effect of changing surface properties on the interaction forces. Several surface as well material properties influence the interaction forces like surface roughness, local chemical composition (e.g. adsorbed surfactants), electrostatic charge, magnetic polarization and surface energies.

Phase contrast AFM

The non-contact as well as the tapping mode imaging of AFM allow characterizing the composition of a heterogeneous surface like that of a nano-composite material, with a high resolution, which is comparable to TEM [1]. For this method, it is not necessary to prepare translucent samples, but only to minimize the surface roughness, e.g. by polishing to avoid a secondary signal. Other approaches apply phase contract for the detection of the presence of nano-bubbles, which otherwise can be characterized with topography measurements in the non-contact mode.

Colloidal Probe AFM (dry)

The colloidal probe provides the real adhesion effects taking into account both the roughness of the substrate as well as that of the particle [2].

Colloidal Probe AFM (wet - liquid cell)

The colloidal probe measurements in the liquid phase allow quantifying the surface modification due to adsorption from the aqueous phase to the substrate, or to the particle at the cantilever itself [3, 4]. With these interaction forces, it becomes possible to predict the stability of agglomerates and flocks. The adsorption of surfactants like modifiers or flotation collectors can be quantified [5] as well as an interaction of the surface with one component of a water-alcohol mixture.

Literature

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