Effects of Surface Heterogeneity and Roughness on Colloidal Interactions

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Significance
Solid phases in engineered and natural systems exhibit both physical (roughness) and chemical (charge) heterogeneities. Knowing the extent and distribution of surface heterogeneities is essential for understanding the interaction between colloidal particles and surfaces.

Studying Microscopic Chemical Heterogeneity
Surface Charge Modification
Surface charge of glass surfaces can be modified by silanization. When using aminosilanes, the silanized regions acquire a positive charge on an otherwise negatively charged native glass surface.

Fabrication of Sub-micrometer Scale Heterogeneity
The micropatterns of silanized surfaces are fabricated by micromolding in capillaries with an elastomeric mold having a patterned relief surface. The elastomeric mold is prepared by casting over a master chip having the desired relief structure.

Modeling Surface Roughness Effects
A boundary element model was developed to calculate the electrostatic interaction between particles. Here, the surface of each particle is represented via a set of triangular elements. The size of the elements in each region is adjusted to better match the local curvature and the relative contribution of the region to the electrostatic interaction.

Direct Observation of Colloid Deposition onto Solid Surfaces
Stagnation Point Flow Setup
A stagnation point flow system is then used to study the influence of microscopic charge heterogeneity on deposition kinetics of colloidal particles. The marked difference in the distribution of deposited particles on homogeneous and micropatterned glass surfaces can be further quantified by comparing the pair correlation functions.

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