Abstract Submitted
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Adhesion and Wetting of Soft Nanoparticles on Textured Surfaces: Transition between Wenzel and Cassie-Baxter States[1] ZHEN CAO, University of Connecticut, MARK STEVENS, Sandia National Laboratories, JAN-MICHAEL CARRILLO, Oak Ridge National Laboratory, ANDREY DOBRYNIN, University of Connecticut — We use a combination of the molecular dynamics simulations and scaling analysis to study interactions between gel-like nanoparticles and substrates covered with rectangular shape posts. Nanoparticle in contact with a substrate undergo a first order transition between Wenzel and Cassie-Baxter states depending on nanoparticle shear modulus, the strength of nanoparticle-substrate interactions, height of the substrate posts and nanoparticle size, R_{p}. There is a range of system parameters where these two states coexist such that the average indentation δ produced by substrate posts changes monotonically with nanoparticle shear modulus. We have developed a model that describes deformation of nanoparticle in contact with patterned substrate. The effect of the patterned substrate can be taken into account by introducing an effective work of adhesion, W_{eff}, which describes the first order transition between Wenzel and Cassie-Baxter states. There are two different shape deformation regimes for nanoparticles with shear modulus G_{p} and surface tension γ_{p}. Shape of small nanoparticles with size $R_p < \gamma_p^{3/2} G_p^{-1} W_{eff}^{-1/2}$ is controlled by capillary forces while deformation of large nanoparticles, $R_p > \gamma_p^{3/2} G_p^{-1} W_{eff}^{-1/2}$, is determined by nanoparticle elastic and contact free energies.

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