Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Nanoparticle adhesion on soft substrates[1] ZHEN CAO, ANDREY DOBRYNIN, University of Connecticut, ANDREW OYER, Naval Research Laboratory, MARK STEVENS, Sandia National Laboratories — Using combination of the molecular dynamics simulations and theoretical calculations we study adhesion of spherical and cylindrical nanoparticles on soft substrates. The nanoparticle and substrate deformations are obtained as a function of the nanoparticle and substrate crosslinking density, nanoparticle size and substrate thickness, surface energy of nanoparticles and substrate, and work of adhesion. We have showed that the classical JKR model can be applied to describe nanoparticle adhesion when deformation of both substrate and nanoparticle are small. In this so-called JKR-regime the deformations of substrates and nanoparticles are determined by balancing the elastic energy of deformed objects and work of adhesion between nanoparticle and substrate. However, in the case of soft substrates and nanoparticles when both objects undergo large deformations their equilibrium shapes are determined by balancing the surface energy and work of adhesion (the so-called wetting regime). We present a simple scaling model describing crossover between JKR and wetting regimes. The model predictions are in a very good agreement with simulation results.

[1]NSF # DMR-1004576

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Date submitted: 13 Nov 2013 Electronic form version 1.4