Patchy nanoparticles at the air-liquid interface: contact angles and adsorption energies measured by neutron reflectivity

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Abstract

The properties of nanoparticles (NPs) at the air-liquid, liquid-liquid, and solid-liquid interfaces have attracted strong interest in the last years for their scientific and technological importance.[1] A better understanding of these interfacial systems is crucial to shed light on complex physical processes like heterogeneous catalysis, electron transfer, biological surface activity, biosensing and self-assembly. The control of the interfacial properties will help to design better systems for controlled emulsions with long stability, improved 2D supracrystals for catalysis, or plasmonic surfaces for SERS among others.

We present here a novel experimental approach based on neutron reflectivity (NR) that allows the *in situ* measurement of the contact angles, energy of absorption and interfacial energies of nanoparticles adsorbed at fluid interfaces.[2] Because our method provides a route to quantify the adsorption and interfacial energies of the nanoparticles *in situ*, it circumvents problems associated to existing indirect methods, which rely on the transport of the monolayers to substrates for further analysis. We illustrate the method by measuring the contact angle of hydrophobic nanoparticles coated by octanethiol (d-OT) and the more hydrophilic patchy NPs coated with a mixture of d-OT and mercaptohexanol (MHol), respectively.[2] The contact angles were also calculated via atomistic molecular dynamics (MD) computations, showing excellent agreement with the experimental data. Our method opens the route to quantify the adsorption of complex nanoparticle structures adsorbed at fluids interfaces featuring different chemical compositions.

References

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Figures