

Department of Physics & Astronomy

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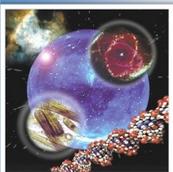
Time: 3:00 p.m. - 4:00 p.m.

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Wetting monolayer structure on metals

The first wetting layer on a solid embodies the boundary condition for water transport along its surface, is the template for ice nucleation, and governs aqueous surface chemistry. The arrangement and energetics of wetting layers accordingly underlies the little understood physics of the "no-slip" boundary condition commonly imposed on Navier-Stokes flows in confined spaces, the identity of the most efficient seeds for raindrop formation, and electrode effects on the rates and selectivity of electrochemical reactions.

Today's talk is focused on the wetting of close-packed, precious metal surfaces, which are both relatively easily prepared, and susceptible to study by a host of surface science techniques. For decades, wetting layers on such surfaces have been thought to be "ice-like" - strained into registry with the metal lattice, but otherwise like the layers that stack to form the naturally occurring crystal, ice Ih. Interpretations of Scanning Tunneling Microscope images of periodic wetting layers on Pt (111) [1], of Temperature Programmed Desorption [2], and of infrared absorption spectra [3] contradict the "ice-like" picture, but submit to a common, physics-based and Density Functional Theory-supported interpretation. It is that several ice-like hexagonal rings of H₂O molecules are replaced by pentagons and heptagons, allowing a compact subset of H₂O's, with planes parallel to the metal surface, to approach the metal exceptionally closely and strongly anchor the wetting layer to it. This motif, amounting to formation of energetically favorable di-interstitial "defects," appears to be general; similar molecular arrangements account for what we know experimentally (and, largely, could not previously explain) of water bonding to Ni, Ru, and Pd close-packed surfaces [4, 5].



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