Expert shares fundamental discoveries of water's behavior on metals

March 14 2011

Previous research into the behavior of water films, specifically molecularly thin ice films on metals, has left many fundamental questions unresolved, questions Sandia National Laboratories' Dr. Konrad Thürmer is beginning to unravel. Studying the interactions between ice and metals helps to decipher the basics of catalysis, corrosion, fuel cells, and the formation of clouds. Thürmer's talk was hosted by Pacific Northwest National Laboratory's Frontiers in Chemical Physics and Analysis Seminar Series. This series brings experts from around the world to discuss current research.

As part of his talk, Thürmer discussed his team's latest research into how water nucleates and grows on surfaces at different temperatures. This research was performed using scanning tunneling microscopy, a technique that, under typical conditions, destroys the delicate water films. Therefore, the team had to develop an innovative non-destructive approach to obtain the images they wanted.

Thürmer and his team began with platinum at 140K, or -207 degrees Fahrenheit. They added a tiny amount of water and watched the ice form. The assumption was that the water would form layers of bulk-structured water. They got surprisingly different results. Instead, the scientists saw the ice undergo a delicate process that began with a lace-like two-dimensional structure and ended with terraced film morphologies.

The lace-like structure contains pentagons and heptagons, as well as the

expected hexagons. By conducting theoretical calculations, the team found that this varied arrangement formed because the water molecules twist to create a flat, irregular low-energy structure with no broken bonds. The structure of the water films they observed may help explain results seen, but unexplained, in other water-on-metal systems.

The discussion on ice nucleation along with current research on surface diffusion, screw dislocations facilitating the growth of metastable cubic ice, and proton arrangement were well received by the audience. "Thürmer's team is doing novel work that is getting at the real molecular-level structure of water on metal surfaces," said Dr. R. Scott Smith, a senior physical chemist who attended the seminar. "This work is near and dear to our hearts."

Provided by Pacific Northwest National Laboratory