

468e Effects of Adsorbed Water Layer Structure on Adhesion Force of Silicon Oxide Nanoasperity Contact in Humid Ambiance

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As relative humidity (RH) increases, the adhesion force of the single asperity contact between silicon oxide surfaces increases in the low RH region, reaches a maximum in intermediate RH, and then decreases in the high RH region. This behavior has been traditionally attributed to the capillary force caused by liquid water condensation in the nanoasperity contact region. However, the capillary force alone cannot explain the exact trend and magnitude of the RH dependence of the adhesion force. We found that the origin of the large RH dependence is the presence of ice-like structure at the first 3 layers of adsorbed water and the viscoelastic behavior of the adsorbed water layer. A theoretical model taking into account these factors is developed, which accurately describes the shape of the adhesion force curve as a function of humidity as well as its magnitude.