Surface Forces between Atomic Layer Deposited Surfaces: Testing DLVO theory

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Measurements of surface forces require surfaces that are extremely smooth and of an appropriate geometry. This has limited the range of materials between which the forces can be measured severely. We have adopted a technique used in electronic materials engineering, known as Atomic Layer Deposition (ALD) as a means of producing a wider range of materials suitable for surface force investigations. Using ALD we can grow the material of interest on a substrate one atomic layer at a time, conformally and with minimal increase in the surface roughness.[1] Using this method we have successfully prepared Al_2O_3, TiO_2[2] and HfO_2 surfaces. Measurements of the surface forces between these surfaces reveals that at the isoelectric point an attractive Van der Waals force well described by Lifshitz theory is obtained. However, when the pH is increased and the surfaces become charged an electrostatic repulsive force is measured that extends into surface contact and no evidence of the van der Waals attraction is seen. We have developed a theory that enables the effect of roughness on surface force measurements to be assessed and find that whilst this describes most of the discrepancy it does not completely resolve the problem.[3] We can conclude that even for very smooth surfaces the effect of surface roughness is considerable and roughness changes the form of the interaction. As such interpretation of real particle interactions using the DLVO theory that ignore the effect of roughness will in many cases give qualitatively incorrect conclusions.

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