Interfacial liquid water on graphite, graphene, and 2D materials

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Solid-water interfaces have a prominent role in a variety of fields such as surface science, geochemistry, electrochemistry, energy storage or molecular and cell biology. Liquids near a solid surface form an interfacial layer where the molecular structure is different from that of the bulk. Yet the molecular-scale understanding of the interactions of liquid water with solid interfaces is unsatisfactory for the lack of high-spatial resolution methods. Here I will present an AFM-based method that provides atomic-scale resolution images of solid-liquid interfaces.

The presentation is divided in three sections. The first section is an introduction to the relevance of solid-liquid interfaces. The second section, presents the features and capabilities of 3D-AFM [1-3] to image with atomic resolution the **three-dimensional** interfacial structure of surfaces immersed in aqueous solutions. The third section reports the structure of interfacial water layers on different **2D materials** from graphene to a few layer MoS_2 ; from hexagonal boron nitride to a few layer WSe_2. Those interfaces are characterized by the existence of a 2 nm thick region above the solid surface where the liquid density oscillates [4-6]. The distances between adjacent layers for graphene, few-layer MoS_2, h-BN and pentacene are ~0.50 nm. This value is larger than the one predicted and measured for water density oscillations (~0.30 nm). The experiments demonstrate that on extended **hydrophobic surfaces water** molecules are **expelled** from the vicinity of the surface and replaced by several molecular-size hydrophobic layers.

References

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Figures 1: Atomic-resolution 3D image of a graphene –water interface.