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Experimental Studies of Nanobubbles at Solid-Water Interfaces[1]

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When a hydrophobic substrate is in contact with water, gas bubbles thinner than 100 nm can form at the interface and stay for long time under ambient conditions. These nanobubbles have significant influence on a range of interfacial processes. For example, they give rise to hydrodynamic slip on the boundary, initiate the rupture of thin liquid films, facilitate the long-ranged interactions between hydrophobic surfaces, and enhance the attachment of a macroscopic bubble to the substrate. Experimentally, it is nontrivial to characterize such small fragile bubbles and unravel their fundamental physical properties. Based on our established procedure for the nanobubble formation, we have systematically studied the formation, stability and response of nanobubbles to external fields (e.g. sonication, pressure drop and temperature rise). By following the bubble morphology by atomic force microscopy, we show that the loss or gain of the nanobubble volume is achieved mainly by the change in the bubble height. The pinning on the three-phase boundary has significant implication on the properties of nanobubbles under various conditions. This talk will cover the effects of the substrate structures on the nanobubble formation, and the response of nanobubbles to the gas dissolution, the temperature increase, the extended gentle ultrasound or the substantial pressure drop in the environment.

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