Nanobubbles and gas molecule-adsorbed layers at solid-liquid interfaces

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Boiling is one of the most familiar phenomena in our daily life and has been investigated by numerous researchers but its initial stage remains unclear. The very initial stage consists of nanoscale gas phase or even gas molecules accumulated on solid surfaces and thus it is highly desired to understand their veiled properties, such as a longevity that cannot be explained by the classical theory and extraordinarily high contact angles. In this talk, I review my findings about nanobubbles and gas molecule-adsorbed layers formed at graphite-water interfaces investigated by using atomic force microscopy (AFM). The results showed that the interfacial nanobubbles are prevented from dissolving into water mainly due to the pinning of the three-phase contact line, resulting in the very flat shape. I also successfully observe the three types of gas molecule-adsorbed layers, namely a micropancake, an epitaxially ordered layer, and a disordered layer. Micropancakes were found to be formed on a disordered layer overlying an ordered layer and showed mobility in the direction of AFM scanning, although the ordered and disordered layer did not move at all. Furthermore, I found that the contact line of micropancakes deformed from circular to zigzag-shaped by heating while avoiding many holes created in the underlying disordered layers. These phenomena are attributed to the strength of gas adsorption onto the HOPG surface.

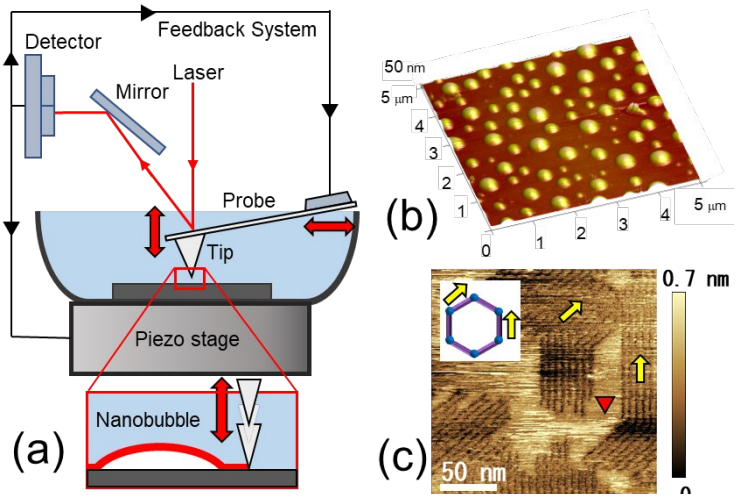

Fig.1 (a) Schematic image of interfacial nanobubble observation by using AFM. (b, c) AFM height images of (b) interfacial nanobubbles and (c) gas molecule-adsorbed layers.