For the last 14 years, a variety of experimental studies have revealed the existence of nanobubbles at liquid/solid surface. Nanobubbles have attracted much scientific interest because of several highly disputed properties and many potential applications in fields from surface to nanofluidics [1]. Previous studies suggested that nanobubbles prefer to form on hydrophobic surfaces [2]. In this work, we prepare a substrate of a flat hydrophilic substrate with a small area covered by a hydrophobic material. The purpose is to see the preference of nanobubble formation on such an inhomogeneous substrate in water. Muscovite mica is a hydrophilic substrate that is strongly attracted to water, but graphene interacts weakly with water. Here we prepare a mica substrate with a small patch of mechanical exfoliated graphene layers. We inject water supersaturated with air on this sample and image the solid/water interface with atomic force microscopy (AFM). Figure 1a shows a height image taken with PeakForce mode. A high density of nanobubbles forms on graphene, but none is seen on the mica. Figure 1b is a higher-resolution image, which shows that nanobubbles can form on graphene of different thicknesses. Our observations demonstrate that the surface hydrophobicity has significant effect on nanobubble formation. Further study may help understanding the accumulation of gases at solid-water interfaces.

References

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Fig. 1: (a) Height image of graphene deposited on a mica surface in air-super-saturated water. (b) A higher-resolution image taken in the outlined region in (a).