Supporting Information (SI) for

Efficient preparation of graphene liquid cell utilizing direct transfer with large-area well-stitch graphene

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Table of Contents:

Supporting Information 1

Raman spectrum of monolayer graphene

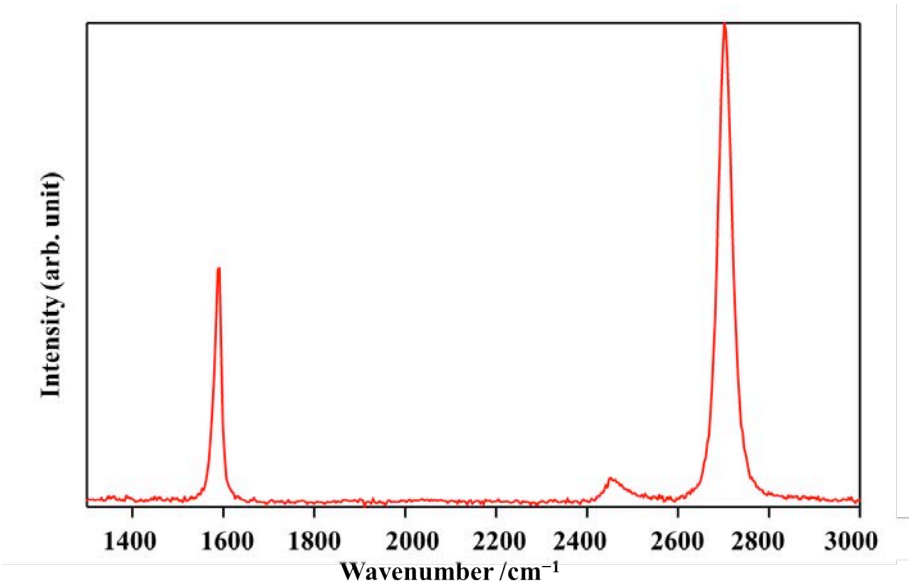

Figure S1: Raman spectrum of graphene on a SiO_2/Si substrate. This spectrum was acquired with an excitation wavelength of 633 nm. The graphene grown on the orientated copper foil was transferred to the SiO_2/Si substrate by applying the direct transfer method, which was the same method used for sample preparation. The spectrum shows intense G and G' band with an intensity ratio of 1 to 2, which is consistent with monolayer graphene. The invisible D band demonstrates the quality of the graphene and our transfer method.

Supporting Information 2

Structural information of copper surface

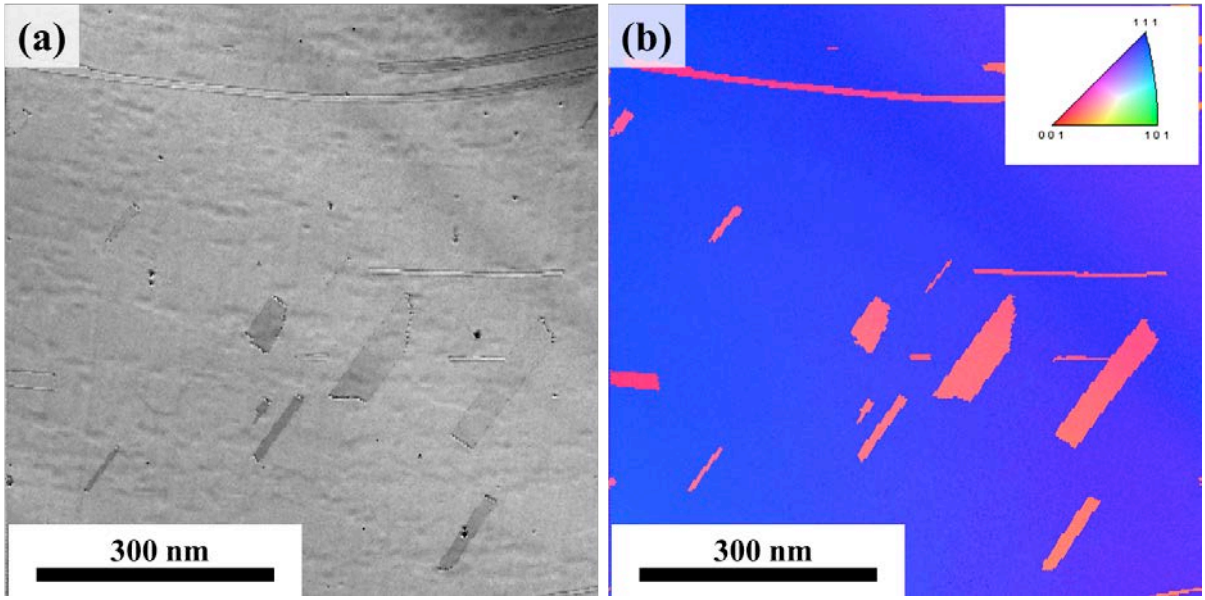

Figure S2: Typical scanning electron microscope (a) and electron backscatter diffraction (b) images of the same area of the copper surface. In (b), the blue area shows the (111) surface and the red area shows the (001) surface. This shows that the H_2 treatment produces mostly (111) surface, but that some (001) surface is observed.

Supporting Information 3
Photographs of direct transfer process

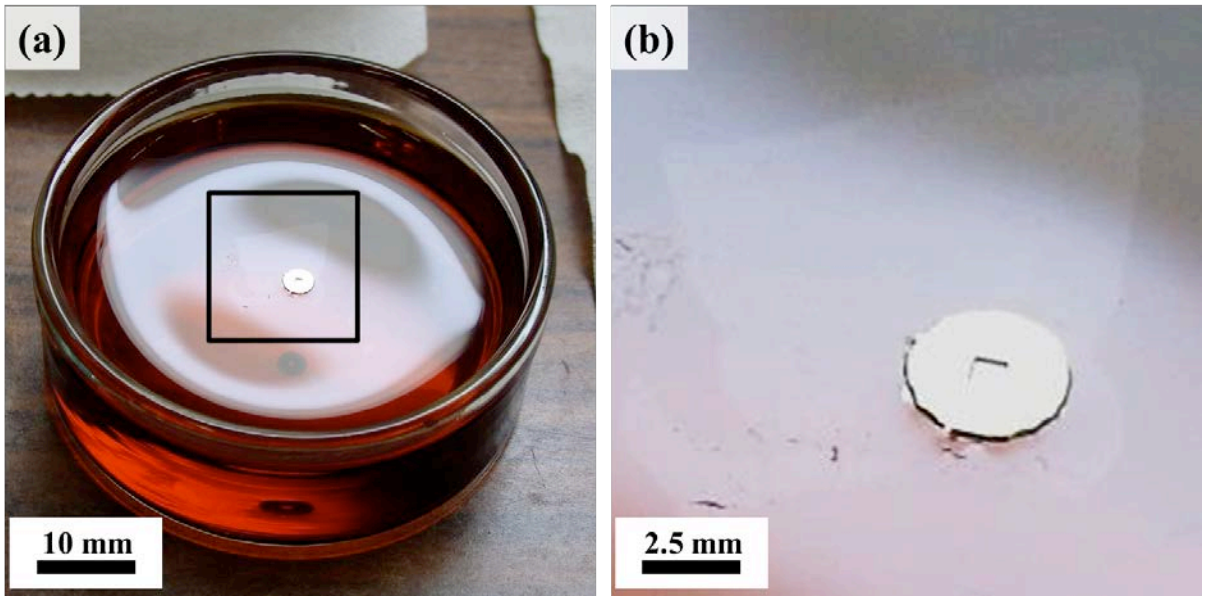

Figure S3: Photographs of the direct transfer process (a) and an enlarged view of the monolayer graphene on the etching solution (b). These photographs show the last step of figure 1. The round, yellow object shows the transmission electron microscopy (TEM) grid with graphene, which is placed on the graphene sheet. It can be seen that the graphene sheet is approximately 10 × 10 mm. In this figure, we prepared the graphene sheet on an aqueous solution of $Fe(NO_3)_2$ for demonstration instead of ammonium peroxodisulfate.

Supporting Information 4

High magnification images of monolayer and bilayer graphene

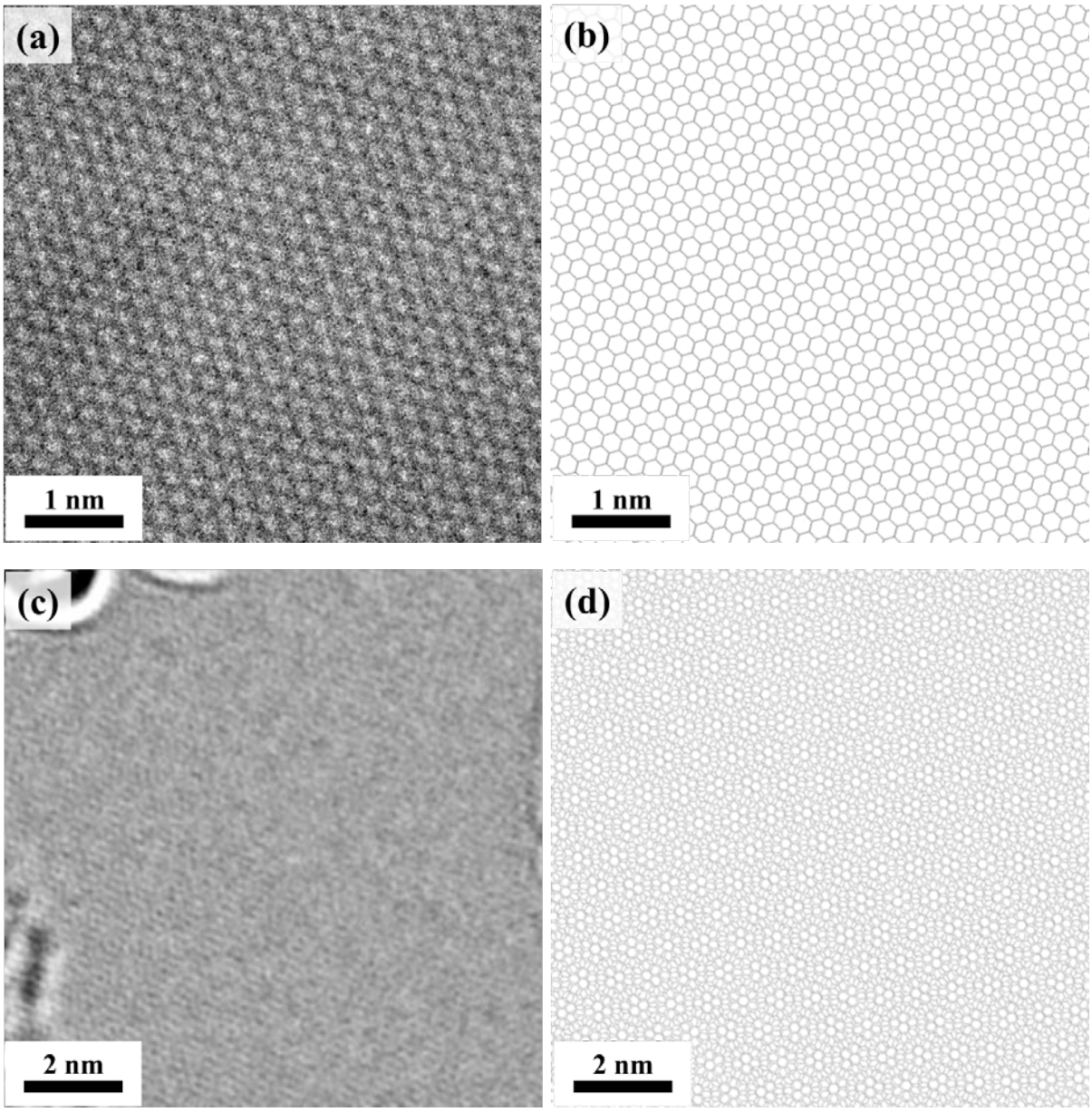

Figure S4: High magnification images of monolayer graphene (a) and bilayer graphene (c). The structure models of each of the TEM images are shown in (b) and (d), respectively. Figure (a) shows the clear lattice pattern of the monolayer graphene and (c) the moiré pattern of the bilayer graphene.

Supporting Information 5

TEM image of graphene liquid cell

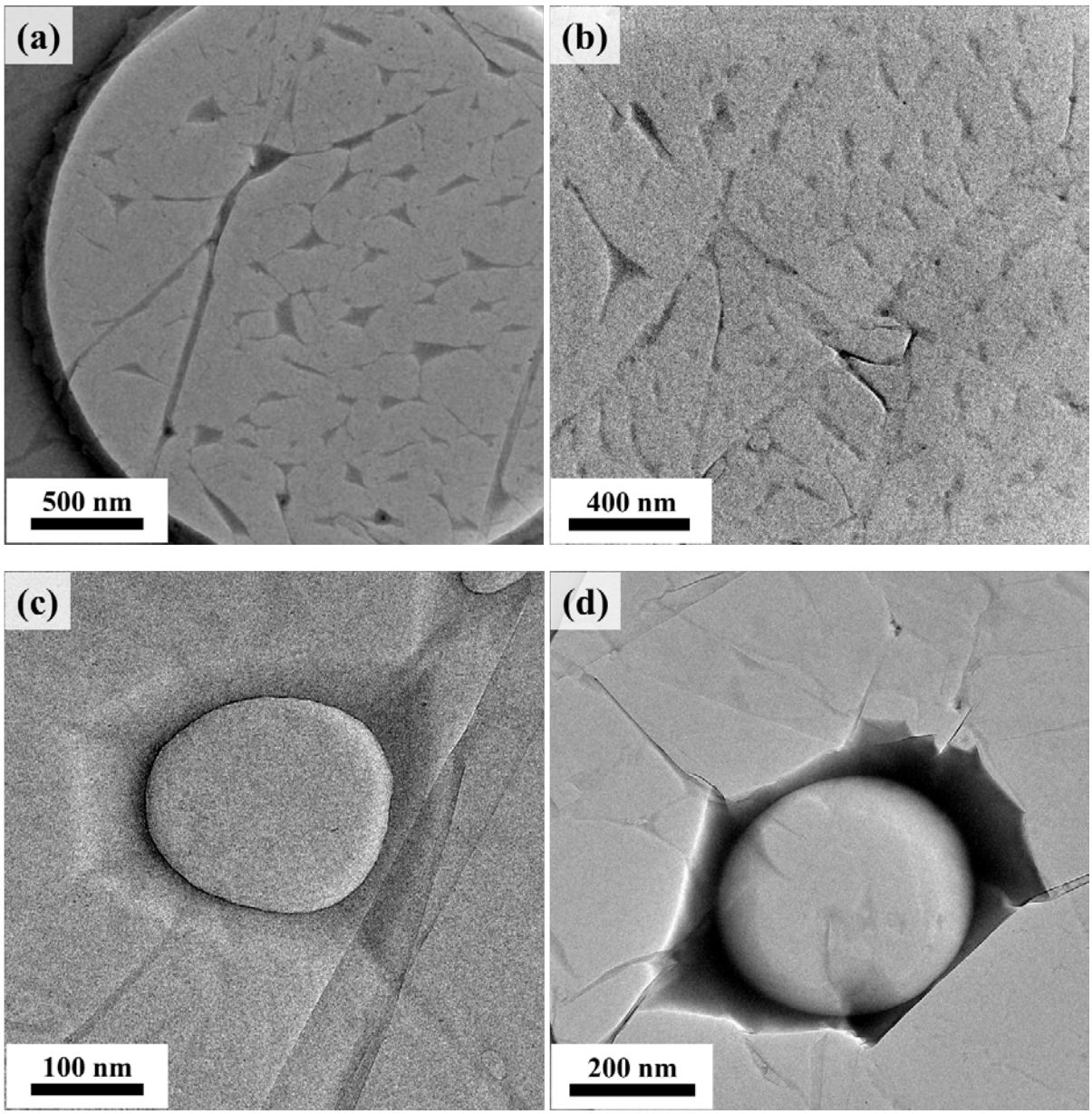

Figure S5: Typical TEM images of the graphene liquid cell. In figure (a), a 2-μm hole in the SiN membrane is observed in the center of image, suspended in which is the bilayer graphene. It can be seen that dozens of liquid cells are produced in each hole of the membrane. As the electron beam converges, bubbles can be observed, as can be seen in figures (b), (c), and (d).