carbon nanomesh: atomic structure and applications

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Introduction

Recently, intense efforts have been focus on the fabrication of the two-dimensional self-assembled nanotemplates, which have preferential sites that accommodate individual nanostructures favoring the formation of the well-ordered nanometer-sized functional arrays.[1, 2] Here we will report the atomic structure of a carbon nanomesh template, which has been demonstrated as a chemically inert nanotemplate for the preparation of monodispersed metal nanoparticles. [3, 4]

(1) Atomic structures

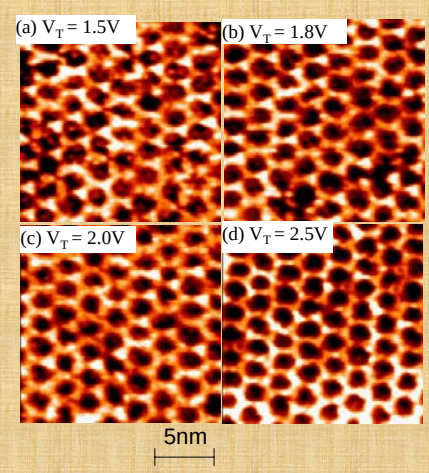

Fig. 1. 15×15 nm² STM filled state images of the carbon nanomesh at different bias. The surface was prepared by annealing the SiC at 1100°C for 5mins.

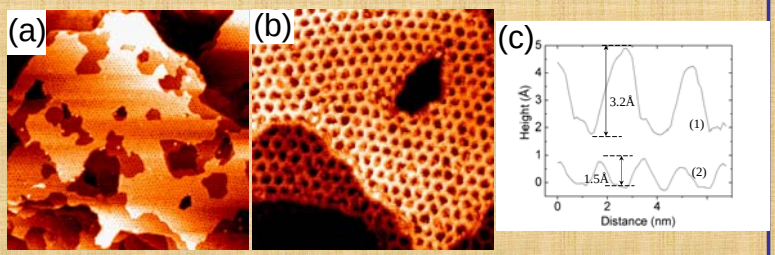

Fig.2. STM images of the carbon nanomesh after prolonged annealing at 1100°C for 20 mins, (a) 150×150 nm² and (b) corresponding 43×43 nm² image. It reveals that the pore size of some honeycombs after prolonged annealing was enlarged.

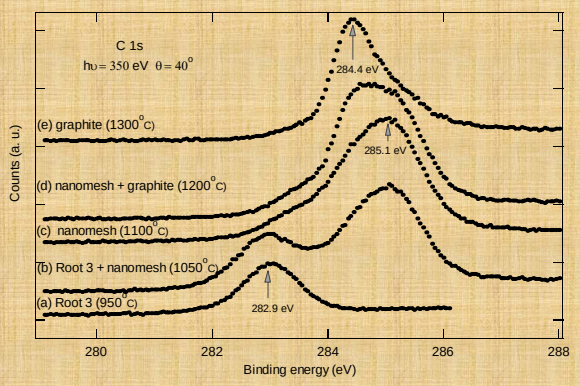

Fig.3. C 1s core level spectra of the 6H-SiC(0001) surface at different stages. (c) corresponding to the pure carbon nanomesh surface. It shows that the carbon nanomesh surface has its own specific surface component located at 285.1 eV, different with the graphite (284.4 eV) and bulk SiC (282.9 eV).

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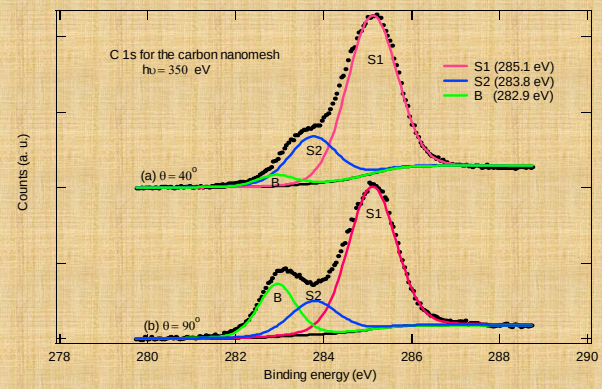

Fig. 4. C 1s core level spectra of the pure carbon nanomesh surface. It shows that two surface related components of the carbon nanomesh structure locate at 285.1 eV (S1) and 283.8 eV (S2).

(2) Applications: Co nanocluster formation

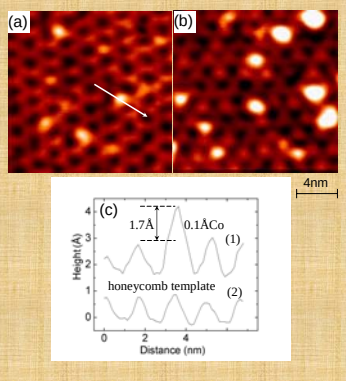

Figure 5. Co coverage:

(a) 0.1ÅCo; (b) 0.2ÅCo;

As shown in Figure 5(a) and 5(b), the Co nanoclusters preferred to adsorb on the corner sites of the honeycomb structures at low coverage (0.1Å and 0.2Å). Therefore, the corner sites of the honeycomb template act as stable adsorption sites for Co nanoclusters at room temperature.

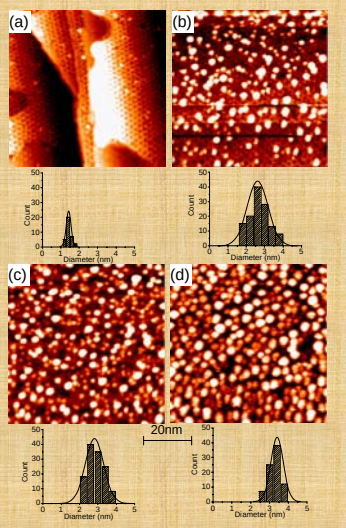

Figure 6. Co coverage:

(a) 0.1ÅCo; (b) 0.5ÅCo;

(c) 1.0ÅCo; (d) 2.0ÅCo.

After the deposition of Co to a thickness of 2.0Å, a full coverage of Co nanoclusters (~3.5nm in diameter) is obtained, as shown in Figure 6(d). We believe that the limit in cluster size observed here is due to constrained diffusion on the porous surface characterized by narrow channels joining the corner sites.

IV. Conclusion

The carbon nanomesh is a superstructure formed by the self-assembly of the carbon atoms at high temperature. Two surface-related components for the carbon nanomesh surface have been identified with a binding energy of 283.8 eV and 285.1 eV, respectively. The monodispersed Co nanoclusters have been fabricated on this carbon nanomesh template. It is found that the corner sites of the nanomesh act as the stable adsorption sites for Co nanoclusters at room temperature.

Reference:
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