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Morphological change of carbon film surface through thermal annealing

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Chemical vapor deposition (CVD) is a well-known technique for synthesizing thin films. In addition, it has also attracted enormous interest in synthesizing micro- ad nano- materials. Among the various materials which have been synthesized, carbon based materials have been studied extensively for a long time because of their superior physical and chemical properties. However, there are few reports for carbon films through thermal annealing. In this research, we have tried to observe the morphological change of carbon film surface through thermal annealing, and to characterize the properties by Raman measurement.

At first, aluminum carbide (Al_4C_3) layer was synthesized in H_2 ambient at 1150˚C for 1 hour on the sapphire (0001) substrate. And then, we synthesized the amorphous carbon film for 4 hours at 1150˚C in nitrogen atmosphere on previously prepared Al_4C_3 layer. Methane (CH_4) gas and trimethylaluminum (TMA) were used as source of carbon and aluminum, respectively. Synthesized carbon layer was annealed for 2 hours at 1000˚C in hydrogen atmosphere. Through the annealing process, we could find the morphological change of carbon film. We observed the morphological change of surface using optical microscopy observation. Figure 1 shows the change of surface morphology after the thermal annealing process. The hexagonal shape of structures was observed on the surface. The structure originates from the center and seems to radiate to all direction. The size of one hexagonal structure was around 40-50 ㎛. Figure 2 show the Raman spectra for the samples without and with thermal annealing, and Raman mapping image taken at the G-peak position, respectivety. The position of Raman peaks were shifted toward shorter wavenumbers after annealing. In addition, we could get Raman mapping measurement about G-peak position through the curve fitting. We confirmed that the synthesized hexagonal shape of structures have shorter wavenumbers than surface.

In summary, we have observed the morphological change of surface after annealing process. And the structures changed with thermal annealing have shorter wavenumbers of G-peak position in Raman experiment.

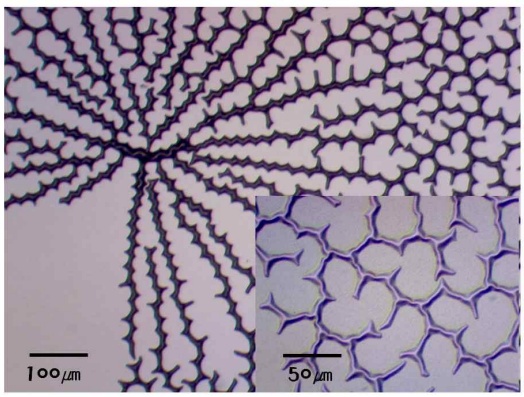

Figure 1 Optical microscopy images of surface after thermal annealing process.

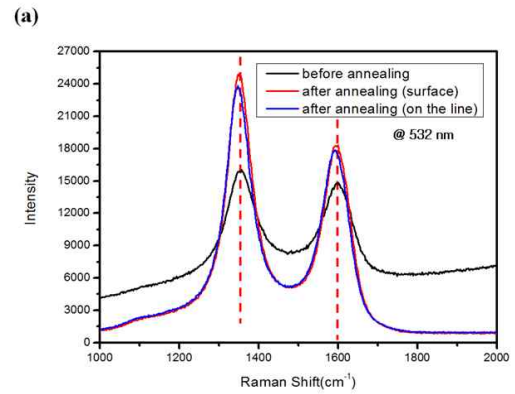

Figure 2 (a) Raman spectra for the samples with and without annealing (b) Raman mapping image at G-peak position