



Crystal structure analysis of nano graphene with XRD

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1. Background and research purpose

Recently, two-dimensional graphene sheets, especially carbon nanowalls (CNW) structure has shown promising characteristics for energy storage, catalyst support material, and various device application [1-2]. A typical CNW structure could be grown on different substrates by a catalyst-free Plasma Enhanced Chemical Vapour Deposition (PECVD) method. Scientifically, having an insight into the growth mechanism of such unique CNW microstructure is of great interest. Therefore, in this study, we have focused on investigating CNW structures grown on different substrates.

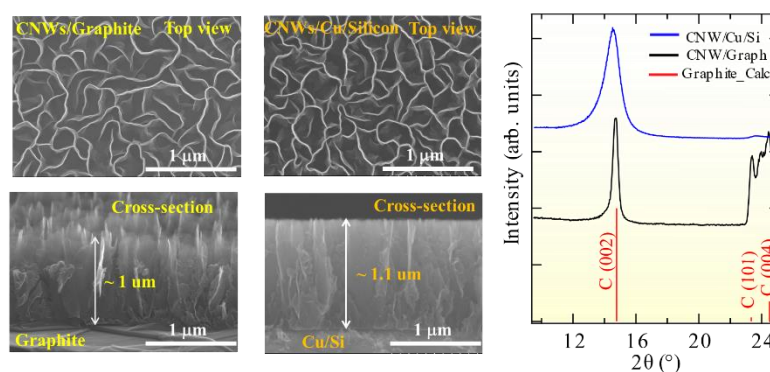
2. Experiment content

The CNWs were grown on copper-coated silicon and graphite sheet using Radial Injection Plasma Enhanced Chemical Vapour Deposition (RI-PECVD) in CH₄/H₂ plasma. The substrate temperature was 700 °C and the gas flow rates for H₂ and CH₄ were 50 and 100 sccm, respectively.

Synchrotron X-ray diffraction measurements were carried out at BL8S1 beamline of the Aichi synchrotron radiation center, Japan. The wavelength of the X-ray was $\lambda = 0.863 \text{ \AA}$ corresponding to 14.3 keV. At this beamline non-coaxial (inplane $2\theta\chi/\phi$) glancing angle XRD measurements were performed for CNWs grown on Cu/Si substrate and graphite sheet. The in-plane measurements were performed to analyze the crystal structure of the thin layer (1 μm) of CNW, which possesses high preferential orientation in the vertical direction.

3. Results and Discussion

The microstructure of CNWs grown on two different substrates was observed by scanning electron microscopy (Figure 1 (left)), which shows similar morphology in the top view and thickness of $\sim 1 \mu\text{m}$ in cross-section view. The diffraction



patterns for in-plane measurements with glancing angle 0.1° are plotted in Figure 1(right), where a prominent diffraction peak corresponding to the (002)

diffraction plane of graphite was observed at 14.73° in both the samples. However, peak broadening for the (002) peak was observed only for the CNWs grown on Cu/Si substrate. Two slightly broadened peaks related to C (004) and C (101) / (100) were confirmed for the CNWs grown on graphite sheet. These results indicate that could be a contribution from the graphite substrate. Hence, we can conclude that the microstructure and the XRD patterns for both samples were nearly similar irrespective of the substrate material.

4. References

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