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# Effect of thermal annealing on crystal orientation of copper foil

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## 1. Background and research purpose

Copper in the form of foil is widely being used as a substrate in chemical vapor deposition techniques to grow carbon-based materials i.e. graphene, carbon nanotubes, carbon nanowalls [1]. In the growth process, parameters such as nucleation rate, morphology, growth rate, and crystal quality of carbon structure are closely related to the surface properties of the Cu foil used as substrate [2]. In the deposition process, Cu foil undergoes a thermal and chemical treatment, which can alter the microstructure and surface quality, resulting in adverse or desirable electronic properties. Therefore, it is important to investigate the effect of thermal treatment on the crystal structure and morphology of the copper foil, which was being used to grow carbon nanowalls using Radial Injection Plasma Enhanced Chemical Vapour Deposition (RI-PECVD) in $CH_4/H_2$ plasma. In this study, high-intensity synchrotron radiation with high-resolution X-ray diffraction (XRD) was implemented to analyze the evolution of crystal structure.

## 2. Experiment content

The copper foil with a thickness of 40 μm was annealed at 700 ℃ for 10 mins under $H_2$ atmosphere. Synchrotron X-ray diffraction measurements were carried out on the beamline BL8S1 at the Aichi synchrotron radiation center, Japan. The wavelength of the X-ray was λ = 0.863 A ° corresponding to 14.3 KeV. At this beamline, θ-2θ XRD measurements were performed on as-received Cu foil and annealed Cu foil. The 2-dimensional X-ray diffraction measurements were performed using PILATUS 100k to analyze the anisotropic distribution of crystalline orientation.

## 3. Results and Discussion

The diffraction patterns for pre and post-annealing of Cu foil are plotted in Figure 1(a), showing the diffraction peaks and corresponding planes appeared for as-received and post annealed Cu foils. Notably, for post-annealing the prominent peak for Cu (220) reduced to a negligible intensity, making the $I_{200}/I_{220}$ ratio from 1 to 2000. The $I_{200}/I_{220}$ and $I_{200}/I_{311}$ ratios also indicated preferential orientation in Cu (200) and Cu (400) direction. Such preferential orientation was also clearly observed in 2-dimensional data (Fig. 1(b)). The transformation of uniform diffraction rings (as-received) to bright spots proves that the thermal annealing at 700 ℃ causes recrystallization to an anisotropic preferential oriented crystal structure.

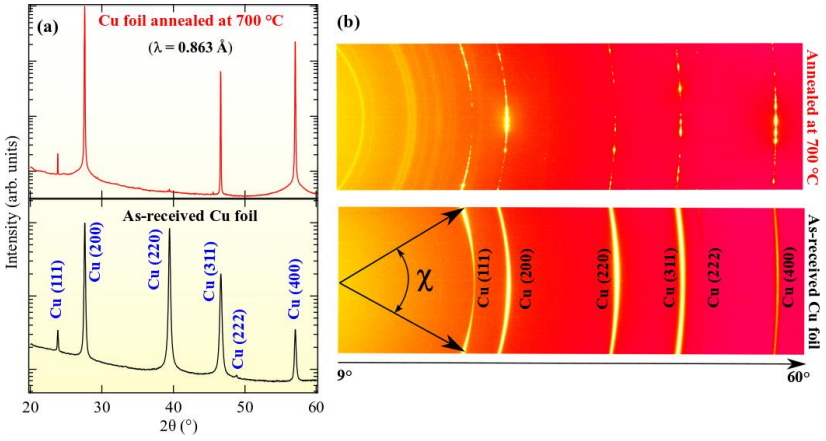


**Figure 1** X-ray diffraction patterns of (a) as-recevied and annealed Cu foil, and (b) corresponding 2-dimensional X-ray diffraction measurements.

## 4. References

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