

XAFS study on implanted Cu ions in silica glass

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An ion implantation method is one of useful methods to modify surfaces of materials, owing to the easy controllability of ion beam position and the exact controllability of the concentration of ions. For the modification of surfaces, it is important to study the atomic structure of implanted ions. Fluorescence XAFS spectroscopy is suitable for studying the atomic structure of dilute components in substrates nondestructively. The structure of implanted Cu ions has been studied by fluorescence XAFS in this report.

O⁺ and Cu⁺ ions were implanted in a silica glass plate at doses of 5×10^{16} ions/cm² and 1×10^{17} ions/cm², respectively. Cu⁺ ions were located at a depth of 1.5 μ m from the surface with a distribution width of 0.58 μ m, according to TRIM code simulation. The glass plate was heated at 800°C in air. XAFS spectra of the glass were measured around the CuK-absorption edge by a fluorescence mode with a Lytle detector equipped with a Ni filter (an average ring current of 18mA, a double Si<111> crystal monochromator). The x-ray intensities were accumulated for 4s at each energy. Signals from the detector were amplified with an external amplifier by the order of 10^{11} . Since the beam size of the incident x-rays measured by photosensitive paper was 8 x 0.5 mm, the total amount of Cu⁺ ions valid for the measurement was 4×10^{15} Cu⁺ ions. CuK-XAFS spectra of Cu₂O and CuO

crystals were measured as references by a transmittance mode.

From the comparison of XANES spectra between the glasses and the reference substances, most of Cu atoms were monovalent in the glasses before and after heat-treatment (Fig.1). The XANES spectrum of the glass heated at 800°C was similar to that of Cu₂O crystal, indicating that Cu₂O crystals were formed in glass after heating at 800°C. Both $k^3\chi(k)$ and RDF curves (Figs. 2 and 3, respectively) supported the result obtained by XANES spectra.

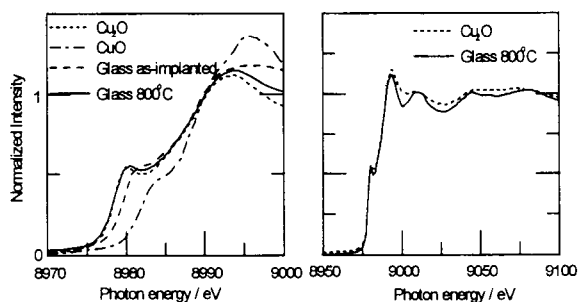


Figure 1 XANES spectra

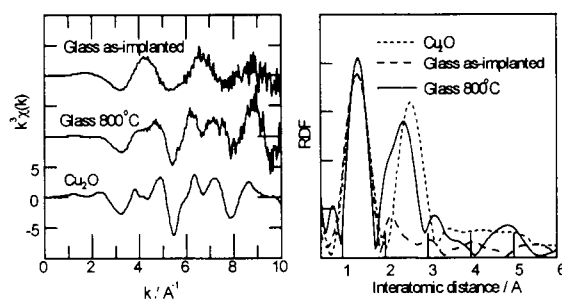


Figure 2 $k^3\chi(k)$ curves

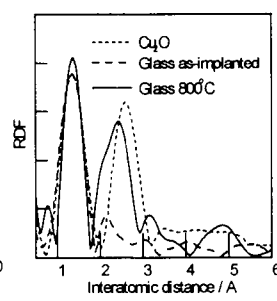


Figure 3 RDF