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BL7U

X-ray absorption spectroscopy of Cu thin films

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1. Background and Research Objectives

These experiments will seek to establish the connection between the electronic structure of the copper catalyst film as well as the properties of the surface of the copper catalyst film, which we can relate to our data on the electrochemical performance of the Cu catalysts. In this experiment, Cu L-edge XANES spectra were measured to evaluate the electronic states of Cu catalyst thin films prepared under various processing conditions.

2. Experimental Details

The measurements were carried out on six types of Cu catalyst thin films with varying deposition rates and film thicknesses. The sample cases brought from Singapore were opened in the glovebox of AichiSR filled with argon gas, and each sample was attached to a sample holder. The sample holders were set in the transfer vessel and transferred into the measurement chamber of BL7U without exposure to the atmosphere. Cu L-edge XANES spectra were measured at AichiSR, beamline BL7U. To investigate the depth-dependent variation in electronic states, three types of measurements were carried out simultaneously: Auger electron yield, total electron yield, and total fluorescence yield.

3. Results and Discussion

The figure shows Cu L_3-edge (~930–935 eV) and L_2-edge (~950–955 eV) XANES spectra measured using the total electron yield method. The vertical axis represents the normalized intensity, and the horizontal axis represents the incident X-ray energy. The peak around 931 eV corresponds to Cu^{2+}, while the peak around 934 eV is associated with Cu^{+} or Cu^{0} [1]. From this figure, it is evident that the oxidation state of the Cu thin film surface varies depending on the deposition conditions. On the other hand, in the spectra obtained using the Auger electron yield method, which is more sensitive to surface electronic states, these differences are observed more prominently (spectra are not shown here). This indicates that the surface oxidation states differ more significantly. The relationship between these spectral differences and the catalytic properties will be investigated in future studies.

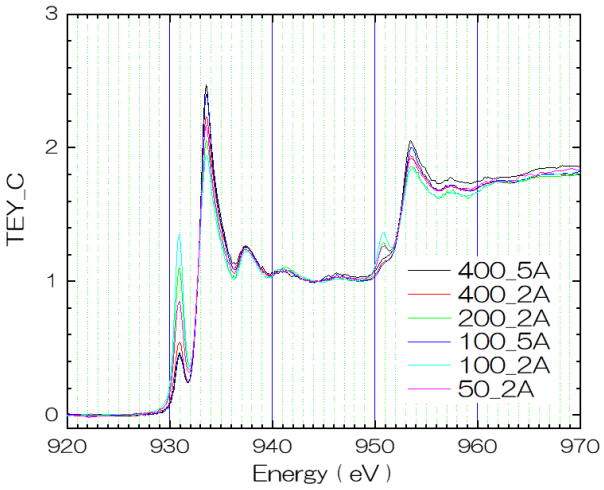

Figure Cu L-edge XANES spectra of Cu catalyst thin films prepared under various deposition conditions. The spectra were obtained using the total electron yield method.

4. Reference

1. Y. Yang, *et. al.*, *J. Am. Chem. Soc.* 21022, 144, 8927-8931.