Ultraviolet Reflectivity Measurement of Copper and Zinc in the 5.8–10.7-eV Region

Hiroki Nakagawa[1], Masahiro Chishima[2], Kohei Sakamoto[2], Toshiharu Kadono[1], and Shin Imada[1]

1) *Department of Physical Sciences, Faculty of Science and Engineering, Ritsumeikan University, 1-1-1 Noji-Higashi, Kusatsu 525-8577, Japan*
2) *Department of Physical Sciences, Graduate School of Science and Engineering, Ritsumeikan University, 1-1-1 Noji-Higashi, Kusatsu 525-8577, Japan*

Although zinc is comparatively stable in air and water and therefore is widely used as a material for corrosion-resistant coating, bright zinc surface rapidly loses its brightness when first exposed to air [1]. This is expected to be the reason why its optical constants are not found in the handbook by Palik [2]. However, inelastic electron scattering experiments in ultrahigh vacuum have enabled estimates of its optical constants [3]. Sufficiently high-energy ultraviolet light can excite 3d electrons, whose binding energy is about 10 eV. In copper, whose atomic number is smaller by only one, visible light above 2 eV can excite 3d electrons above Fermi level, yielding the reddish color.

In this article we report far ultraviolet reflectivity measurement of copper and zinc polished in air. Measurements have been performed at BL1 in the normal reflection geometry in vacuum of about 10^{-6} Pa.

Figure 1 shows the results of the reflectivity measurement. In copper, the slope of the spectrum changed around 7.5 eV. In zinc, it changed around 9.5 eV, above which reflectivity was nearly zero. Figure 2 shows the reconstructed reflectivity based on the literature. For copper, optical constants obtained from optical measurements [2] were used. For zinc, optical constants estimated from inelastic electron scattering [3] were used. The experimentally obtained reflectivity in Fig. 1 seems to be systematically smaller than the reconstructed one. This suggests that the polishing of the surface of the samples was not enough. Especially in the case of zinc, in-situ polishing may be needed for intrinsic measurement of reflectivity. Next, let us focus on the photon-energy dependence of the slope of the spectrum. In Fig. 2, the slope changes around 7.3 eV for copper and around 9.5 eV for zinc. These tendencies closely coincide with those of experimental results as pointed out above. Further careful measurements will take place in near future.

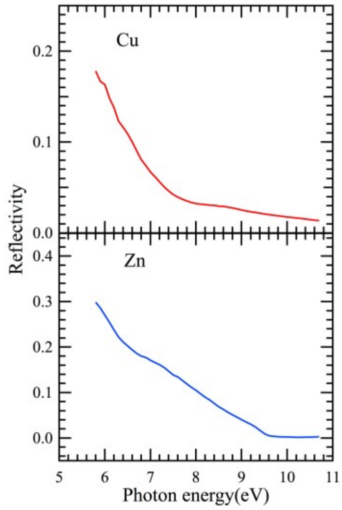

Fig. 1. Measured reflectivity of copper and zinc in normal reflection geometry.

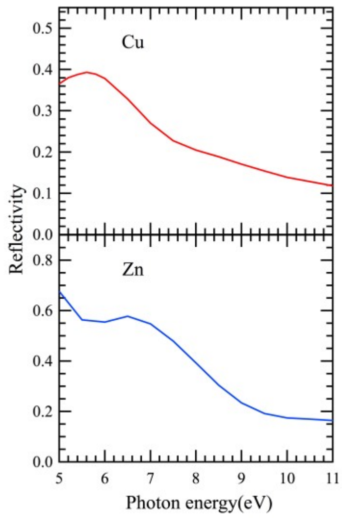

Fig. 2. Reconstructed reflectivity at normal reflection of copper [2] and zinc [3] based on optical constants, where inelastic electron scattering data are used for zinc.

References

[1] R. J. McKay and R. Worthington, *Corrosion Resistance of Metals and Alloys* (Reinhold, New York, 1936).
[2] E. D. Palik, *Handbook of Optical Constants of Solids I* (Academic, New York, 1985); *Handbook of Optical Constants of Solids II* (Academic, New York, 1991).
[3] W. S. M. Werner, K. Glantschnig and C. Ambrosch-Draxi, J. Phys. Chem. Ref. Data, **38**, 1013 (2009).