$Cu_3Au(111)$合金表面の耐酸化保護膜形成

The protective layer formation on $Cu_3Au(111)$ surface

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Initial stage of corrosion is one of the central topics in material science [1]. It is required for the industrial applications to elucidate corrosion processes and to develop corrosion-resistant materials. In the present study, we report results of our detailed studies on the reactivity of oxygen during the initial stages of $Cu_3Au(111)$ oxidation with a hyperthermal O_2 molecular beam (HOMB) with variable incident energies, using X-ray photoemission spectroscopy (XPS) measurements in conjunction with synchrotron radiation (SR).

All experiments were done using the Surface Reaction Analysis Apparatus (SUREAC 2000) constructed in BL23SU at SPring-8 [2, 3]. The base pressure of the surface reaction chamber was below 2×10^{-8} Pa. The $Cu_3Au(111)$ sample was cleaned by repetitive sputtering with 2 keV Ar^+ and annealing at 823 K, until no impurities were detected anymore by SR-XPS, and a sharp (1 × 1) LEED pattern was observed for $Cu_3Au(111)$. After irradiating a proper amount of HOMB normal to surface, SR-XPS spectra were measured at 0° and 70° from the surface normal. The flux density of the HOMB is about 2×10^{14}, 1.6×10^{14}, 0.7×10^{14}, 6.4×10^{14} and 2.4×10^{14} molecules cm^{-2} s^{-1} at kinetic energies of 2.3, 1.1, 0.6, 0.5 and 0.3 eV of HOMB. All experiments were performed at a sample temperature of 300 K.

Figure. 1 shows the O-uptake curves produced by integrating a series of O-1s spectra. At low coverage, the 2.3 eV HOMB is less effective than the one with 0.6 eV, because of the excess energy. As the coverage increase, the repulsive interaction of O atoms raises the activation barrier of the dissociative adsorption. Thus, at high coverage the oxidation efficiency for the 2.3 eV HOMB surpasses that for the 0.6 eV HOMB. For the 2.3 eV HOMB at high coverage, the oxidation efficiency is much weaker for $Cu_3Au(111)$ than for Cu(111). The Au rich protective layer formed on the $Cu_3Au(111)$ causes the difference by preventing the diffusion of O atoms deeper into bulk.

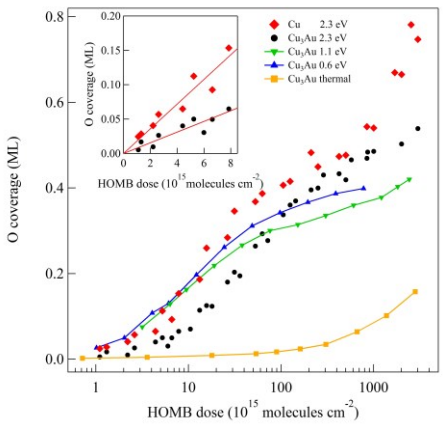

Figure. 1 O-uptake curves on Cu(111) and $Cu_3Au(111)$

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