

## Electronic state analysis of Cu<sub>3</sub>Pt(111) surfaces

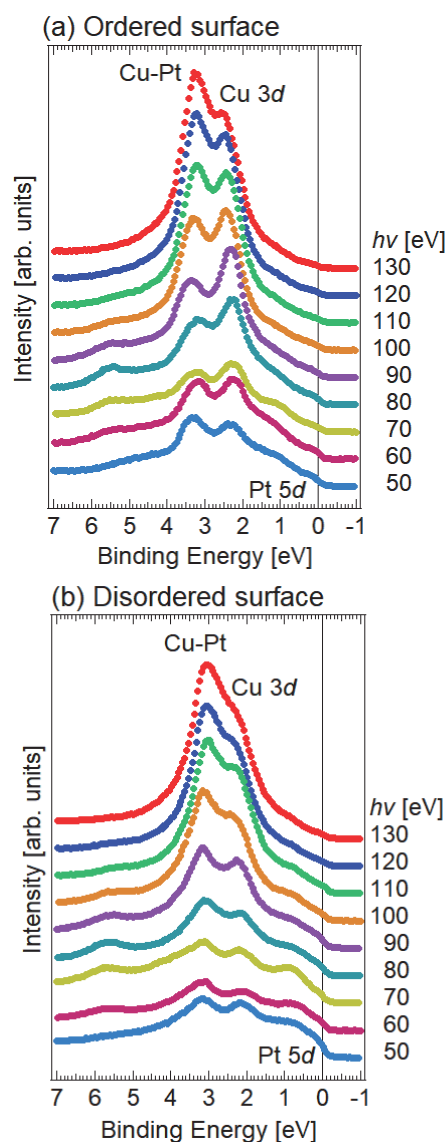
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The physical and chemical behaviors at metal alloy surfaces are crucial for several technological processes. More specifically, the Pt–Cu system has proven to be particularly well adapted in industrial applications for hydrocarbon reactions and oxidation of CO. The mechanism of adsorption, however, is not fully understood. Various electronic and structural reasons have been given to explain these phenomena. The stoichiometric Cu<sub>3</sub>Pt alloy undergoes a bulk order-disorder phase transition at around 850 K [1]. It is important to find the electronic properties of alloy surfaces because the catalytic activity is affected by surface structure. In this study, we report the electronic states of ordered and disordered Cu<sub>3</sub>Pt(111) surfaces.

The experiment was performed at beamline 8 named SORIS set up at SR Center, Ritsumeikan University [2]. The sample was cleaned by the cycles of Ar<sup>+</sup> sputtering and annealing. We prepared two different surface phases: annealing at 670 K results in the (1×1) disordered surface and annealing at 970K results in the (2×2) ordered surface, which were confirmed by reflection high-energy electron diffraction (RHEED). The photoelectron spectroscopy (PES) measurements were performed at room temperature (RT) under ultrahigh vacuum (UHV) of  $\sim 1 \times 10^{-7}$  Pa.

Figure 1 shows the valence band spectra observed for the ordered and disordered surfaces as a function of photon energy, respectively. The broad feature around 1 eV is attributed to Pt 5*d* states and that at 2.4 eV to Cu 3*d* state. The structure around 3 eV is caused by a hybridization of Cu and Pt states (Cu-Pt) [3]. The intensities of Cu 3*d* and the hybridized states increase with increasing photon energy for both surfaces. These results come from the change of the atomic cross section ratios between the Cu 3*d* and the Pt 5*d* states depending on the incident photon energy. Note that the peak position shifts with photon energies are also due to the effect of the band dispersions, i.e. so-called normal emission angle-resolved PES. Comparing the ordered and disordered surfaces, the Cu 3*d* state at 2.4 eV is more enhanced for the ordered surface. These results indicate that the surface composition for the disordered one has larger amount of Pt.



**Fig. 1** Valence band spectra of ordered (a) and disordered (b) Cu<sub>3</sub>Pt(111) surfaces.

### References

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- [2] Y. Kido, H. Namba, T. Nishimura, A. Ikeda, Y. Yan and A. Yagishita, *Nucl. Instrum. Methods B* **136**, 798 (1998).
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