Growth and electronic properties of Rh and Au nanoclusters supported on copper oxides grown on Cu(110)

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Abstract

We first studied varied phases of cooper oxide thin films, grown on oxidizing Cu(110) surface. As the oxide thin films with different phases may change the catalytic properties of metal clusters supported on them, it is important to control and understand the phases of the copper oxides. A (2×1) oxide phase was yield on exposing Cu(110) to oxygen of 1 - 40 L at 300 K and 500 K and then annealing at 500 K for 10 minutes and 10 - 30 minutes, respectively. Both RHEED and PES results indicated that the Cu(110) surface was fully covered by Cu(110)-(2×1)O after exposing to $\geq$ 5 L of oxygen with further heat treatment mentioned above. Instead, both (2×1) and (6×2) phases coexisted when exposing Cu(110) to $\geq$ 10 L of oxygen at 500 K and without further post-annealing. Varied phases of cooper oxide thin films were also studied by STM. We also studied Rh and Au nanoclusters, grown by vapor deposition on ordered varied copper oxide thin-film, as a function of coverage. PES results indicated that the electronic properties of clusters varied with their size. For Rh nanoclusters at low coverage (0.05 and 0.1 ML), Rh 3d core-levels feature located at 306.3 eV, about 0.7 eV lower than bulk value. As the coverage reached to 3 ML, the feature shifted to 306.7 eV. Furthermore, Rh 3d core-levels features of Rh nanoclusters supported on 3 kinds of copper oxides almost showed no difference. For Au nanoclusters at low coverage (0.05 to 0.5 ML), Au 4f core-levels feature located at 84.3 eV, about 0.3 eV higher than bulk value. As the coverage reached to 3 ML, the feature shifted to 84.4 eV. In addition, the growth of Rh and Au nanoclusters was also characterized by STM.

Keywords – Rh, Au, Nanoclusters, Copper oxide, Cu(110)