

Interactions of oxygen with Pd films on Ta : In-situ XPS study

Hyun Ook Seo, Kwang-Dae Kim, Wei Sheng Tai and Young Dok Kim*

Department of Chemistry, Sungkyunkwan University, Suwon, 440-746, Korea

Behaviors of samples with different Pd thicknesses in the reaction with oxygen were studied by in-situ X-ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM). Depending on the Pd thickness, various behaviors in reaction with oxygen were observed. In the case of the sample with a Pd thickness of 3.0 nm, a new low-binding-energy component appeared in the Pd 3d level upon O₂ exposure at 250 °C. After CO exposure at 200 °C, decrease in the relative intensity of the low-binding-energy component was observed, indicating that the oxygen atoms formed at 250 °C on this Pd film can react with CO to CO₂. For the sample with a Pd thickness of 5.0 nm, no change in the Pd 3d spectrum was observed after exposure to O₂ at 250 °C while a positive shift of the Pd 3d level due to the oxidation of Pd was observed after exposure to O₂ at a higher temperature (300 °C). A subsequent CO exposure at 200 °C could not reduce Pd-oxide layers, as confirmed by the unchanged Pd 3d spectra after CO treatment, i.e. Pd-oxide is not reactive for CO oxidation. In the case of Pd/Ta system, increase in the intensity ratio between oxidic and metallic Ta 4f states could be observed upon O₂ treatment at 250 °C while no change in the Ta 4f state could be found for a bare Ta sample without Pd. It indicates that Ta can more easily be oxidized in the presence of Pd.