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Resolving the nature of SMSI among Au-CoOx model catalyst

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Bicomponent heterogeneous catalysts, often composed of noble metals (NMs) supported on transition metal oxides (TMOs), attract much interest due to their prominent performance in catalytic processes. Results from Prof. Gabor Somorjai's group [1] demonstrate a 500-fold higher reactivity of catalytic CO oxidation over Pt/Co3O4 catalysts than other oxide-supported Pt nanoparticles (Fig.1, left). Typically, prior to catalytic reaction, pre-treatment under an H2 atmosphere at 573 K is conducted, which produces metallic Pt and a partially reduced CoO substrate. More importantly, oxide moieties originating from the support further migrate over the metallic nanoparticles, and can totally cover the underlying NM. This newly-formed catalyst is known as the inverse catalyst and hints at the atomic scale nature of active sites which can exhibit the so-called strong metal-support interactions (SMSI).
Herein, employing ambient pressure X-ray photoelectron spectroscopy (AP-XPS) on CoO/Au(111) model catalysts, we observed: (1) CoOx of monolayer thickness wetting onto Au(111) substrate after metallic bilayer Co island exposed to O2 ; (2) Reversible adsorption of CO on partially oxidized CoO (Fig.1, right); (3) Reduction of CoO after annealing in CO atmosphere. Due to the charge transfer between ultrathin CoO and electronegative Au substrate, the Co(II) atoms in direct contact with Au support have a unique electronic structure and we believe are responsible for the observed reactivity of the supported monolayer CoOx layer. We are currently pursuing investigations using ambient pressure scanning tunneling microscopy (AP-STM) and theoretical calculations to achieve more fundamental insights into SMSI effects at the atomic scale on CoO/Au(111) model systems.

if "Other", please specify:

surface science

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No

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