Ag on Pt(111): Changes in electronic and CO adsorption properties upon
PtAg/Pt(111) monolayer surface alloy formation

T. Diemant, K.M. Schüttler and R.J. Behm*

Institute of Surface Chemistry and Catalysis, Ulm University,
Albert-Einstein-Allee 47, D-89081 Ulm, Germany

Abstract

The electronic and chemical (adsorption) properties of bimetallic Ag/Pt(111) surfaces and their modification upon surface alloy formation, i.e., during intermixing of Ag and Pt atoms in the top atomic layer upon annealing, were studied by X-ray photoelectron spectroscopy (XPS) and, using CO as probe molecule, by temperature-programmed desorption (TPD) and infrared reflection absorption spectroscopy (IRRAS), respectively. The surface alloys are prepared by deposition of sub-monolayer Ag amounts on a Pt(111) surface at room temperature, leading to extended Ag monolayer islands on the substrate, and subsequent annealing of these surfaces. Surface alloy formation starts at ~600-650 K, which is evidenced by a change of the core level shifts (CLSs) of the Ag(3d5/2) signal in the XP spectra. The TPD and IRRAS measurements demonstrate a distinct change of the CO adsorption properties when going to the intermixed PtAg surface alloys. Most prominently, we find the growth of a new desorption feature at higher temperature (~550 K) in the TPD spectra upon surface alloy formation. This goes along with a shift of the CO\textsubscript{ad} related IR bands to lower wave number. Both XPS and TPD results suggest that surface alloy formation is almost completed after heating to 700 K and no further significant changes occur in the surface alloy layer between ~700 and ~850 K until Ag desorption sets in.

Keywords: Bimetallic Surface; Surface Alloys; Chemisorption; Carbon monoxide; X-ray photoelectron spectroscopy; Temperature programmed desorption; IR spectroscopy; Surface alloy formation

Submitted. 24.06.2015

* Author, to whom correspondence should be sent, e-mail: thomas.diemant@uni-ulm.de