

Hydrogen Electrochemistry on Bimetallic Single Crystal Surfaces

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The need to understand the key structure/composition relationships governing the electrocatalytic behavior of metal surfaces continuous to motivate fundamental studies of surface processes at the solid-liquid interfaces. To this end, systematic variation of surface crystallography and or surface composition has been employed to delineate very important electrocatalytic trends. Although the field is still in its infancy, a great deal has already been learned and trends are beginning to emerge that give new insight into the true relationship between the surface structure/composition and electrocatalytic activity.

In this paper, we present recent developments in electrocatalysis of the hydrogen reaction on Pt, Au and Ag single crystal surfaces and Pt (Au,Ag)-bimetallic surfaces in acid and alkaline solutions. Four major issues concerning the hydrogen evolution and hydrogen oxidation reactions will be discussed in details: i) ex-situ (Auger electron spectroscopy and low energy ion scattering) and in-situ (surface x-ray scattering) characterization of Pt, Au, Ag bimetallic surfaces; ii) microscopic levels of interaction of ions, viz. H_{upd} , OH_{ad} , Cl_{ad} , Cu_{upd} , with metal surfaces and their effects on the formation of reactive intermediates; iii) pH effects and iv) temperature effects.

By focusing on the mechanism of action in electrocatalysts at Pt(hkl), Au(hkl), Ag(hkl), Pt(hkl)-Pd, Au(hkl)-Pd and Ag(hkl)-Pd surfaces we demonstrate that the ability to make a controlled and well-characterized arrangement of two elements in electrode surface and even near the surface region presages a new era of advances in our knowledge of the hydrogen reaction.

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