

## ACTIVATION OF H<sub>2</sub> EVOLUTION BY MICRO- TO NANOSIZED COMPOSITE ELECTROCATALYSTS

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The activity of electrodes can be modulated using different, intimately mixed components. In this work we report on studies of H<sub>2</sub> evolution on three different electrode systems:

- 1) RuO<sub>2</sub> + RhO<sub>x</sub> in acid solution;
- 2) Co<sub>3</sub>O<sub>4</sub> + IrO<sub>2</sub> in alkaline solution;
- 3) Ru on Ni in alkaline solution.

Rh+Ru oxide electrodes were prepared by thermal decomposition at 400 °C of RuCl<sub>3</sub> + RhCl<sub>3</sub> over all the composition range. XPS analysis showed that the surface is enriched with the Rh phase. Since pure RhO<sub>x</sub> is more active than RuO<sub>2</sub> [1,2], the activity of RuO<sub>2</sub> increases as RhO<sub>x</sub> is added, reaching a plateau at about 30% Rh content, with evident economic advantage due to the high cost of Rh precursors. Whereas pure RhO<sub>x</sub> is unstable towards cathodic reduction, RuO<sub>2</sub> stabilizes RhO<sub>x</sub> for Rh contents lower than 70%.

Previous work has shown that RuO<sub>2</sub> is strongly surface active in mixture with Co<sub>3</sub>O<sub>4</sub> [3,4]. In this work we investigated mixtures of IrO<sub>2</sub> + Co<sub>3</sub>O<sub>4</sub> prepared by thermal decomposition at 450 °C of suitable precursors. The resulting materials are surface enriched with IrO<sub>2</sub>. Surface characterization was performed by means of voltammetric curves, XPS and SEM. The electrocatalytic activity was investigated by means of steady-state polarization curves in alkaline solution. Due to surface enrichment, maximum activity was attained with a relatively small Ir content.

Small clusters of Ru were formed on Ni by spontaneous deposition from an acidic solution of RuCl<sub>3</sub>. The morphology of the overlayer was observed to depend on concentration of acid and of precursor as well as solution temperature. The presence of Ru on the Ni surface was confirmed by SEM and XPS. Ru activates Ni for H<sub>2</sub> evolution by hundreds of mV. The Tafel slope decreases from that typical of Ni to that of Ru, while voltammetric curves exhibit a region where H adsorption/desorption peaks appear.

*Acknowledgements.* Work supported by MURST (Cofin2000), and National Research Center (CNR).

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