INTERIONIC NATURE OF SYNERGISM IN CATALYSIS AND ELECTROCATALYSIS

Professor **Milan M. Jaksic**

Department of Chemistry, Institute of Food Technology
University of Belgrade, Belgrade, Yugoslavia

Ημ/νία: 30.06.99
Ώρα: 19:00
Τόπος: Αίθουσα Σεμιναρίων κτιρίου ΕΙΧΗΜΥΘ.

A b s t r a c t

Plentiful of the Gschneidner type volcano plots along the Periodic Table has shown the periodicity of various properties of transition metals, primarily so called symmetric bonding-antibonding features. However, the properties associated primarily with the *d*-band, such as the adsorption of intermediates in the *rds* of catalytic reactions, the Pauling *d*-character and others, usually behave asymmetric features. Such volcano plots have been used to determine the optimal *d*-state for various electrode and catalytic reactions for both individual and composite catalysts.

The hypo-hypo-*d*- or hyper-hyper-*d*-electronic combinations (the former with up to 5 non-paired *d*-electrons, like Ti, Zr, Hf, etc., the latter with paired *d*-electrons such as Pt, Ni, Pd, etc.) of transition elements always give rather smooth phase diagrams of melting point changes from one to another constituents. Contrary to that, the hypo-hyper-*d*-electronic combinations of transition metals characterizes the appearance of stable Laves type intermetallic phases; the more remote the two constituents along the Periodic Table, like La-Ni combination, the more intermetallic phases appear along their phase diagram. Such state of facts has lead us to the idea that the hypo-hyper-*d*-electronic phase diagrams might behave as the part of the Periodic Table with the behaviour of intermetallic phases in between as the missing elements along the transition metal series. Such assumption has been proved on plentiful of such phase diagrams (Mo-Ni, Zr-Ni, Ti-Ni, Mo-Co, Mo-Pt, Hf-Pd, W-Co, etc.), and the synergetic electrocatalysts for the hydrogen evolution reaction (*her*) appear exactly at the average d^8-electrons as predicted from volcano plots of individual metals. Along such phase diagram appear typical volcano plots in various physical properties otherwise characteristic for individual transition metals (electrocatalytic activity, work function, bonding effectiveness, H/D separation efficiency, etc.).

In the light of such approach, based on the Fermi dynamics and Brewer structural bonding factors, there has been clearly shown that the synergism and (electro)catalytic activity arises as the interionic effect and that there already exist synergetic catalysts in metallic lattice, ions in hypo-hyper-*d*-interaction with metal substrate and hypo-hyper-*d*-electrnic combinations of salts upon indifferent or interacting metal substrates.