

## **Hydride Formation, Magnetic and Transport Properties of Nickel and Nickel-Based Alloys**

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Dedicated to Prof. Dr. B. Baranowski in honour of his pioneering  
work on the nickel-hydrogen system  
and on the occasion of the 45th anniversary  
of the discovery of nickel hydride.

We review the discovery of hydride formation in nickel and discuss how the incorporation of interstitial hydrogen into the metal lattice of nickel and some nickel-based alloys affects the magnetic and transport properties.

## Synthesis and Characterization of Nickel(II), Cobalt(III) and Iron(III) Complexes of the Schiff Base 1-(2,3-Dihydroxybenzylidene)thiosemicarbazone

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Ni(II), Co(III) and Fe(III) complexes of the Schiff base 1-(2,3-dihydroxybenzylidene)thiosemicarbazone (Hdhbtsc) have been prepared and characterized by elemental analysis, infrared spectra, thermal analysis, molar conductivity and magnetic measurements. The results indicate the formation of 1:2 metal to ligand complexes with empirical formulae  $[\text{Ni}(\text{Hdhbtsc})_2(\text{Cl})_2]$  and  $[\text{M}(\text{dhbtsc})_2(\text{Cl})(\text{H}_2\text{O})]$ , (Hdhbtsc = the Schiff base; dhbtsc = anionic form of the Schiff base;  $\text{M} = \text{Fe}^{3+}$  or  $\text{Co}^{3+}$ ). The three new complexes are six coordinate and octahedral, where the ligands behave as bidentate chelating agents in the neutral form with  $\text{Ni}^{2+}$  and in the uninegatively charged form with  $\text{Fe}^{3+}$  or  $\text{Co}^{3+}$ .

## **Complexes of La(III), Sm(III), Tb(III), Dy(III), Ho(III) and Er(III) Ions with Morin**

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New solid complex compounds of La(III), Sm(III), Tb(III), Dy(III), Ho(III) and Er(III) ions with morin were obtained. They were characterized by elemental analysis, thermogravimetric studies and spectrophotometric determination of metal ions. The molecular formulae of the compounds are:  $\text{Ln}(\text{C}_{15}\text{H}_9\text{O}_7)_3 \cdot n\text{H}_2\text{O}$ , where  $n = 6$  for La, Sm, Tb, Dy and  $n = 5$  for Ho and Er. Low molar conductances of the complexes (which correspond to non-electrolytes) and the  $\pi\text{-}\pi^*$  bands of ligand and the CT bands  $\text{L} \rightarrow \text{M}$  in UV-VIS spectra of the methanol solutions of the complexes were established. On the basis of  $^{13}\text{C}$  NMR and IR spectra, it was supposed that morin was bound to the lanthanide ions *via* C(4)=O and C(3)–oxygen.

## Complexes of Cadmium(II) and Mercury(II) with Cytidine 5'-Monophosphate and Diamines in Ternary Systems

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Formation of Cd(II) and Hg(II) complexes in ternary systems with cytidine 5'-monophosphate (*CMP*) and diamines (*en*, *tn*, *Put*) has been studied. In Hg(II)/*CMP*/diamine systems the formation of heteroligand compounds is accompanied by the occurrence of non-covalent interactions and the formation of molecular complexes. The presence of polyamine in ternary systems does not change the metal-nucleotide mode of coordination. Similarly as in the binary Hg(II)/*CMP* system, the metallation involves the donor endocyclic nitrogen N(3) atom and *CMP* phosphate group. On the other hand, in the Cd(II)/*CMP* system, the introduction of a polyamine changes the coordination mode of the nucleotide. Phosphate group, inactive in binary systems, takes part in the complexation in ternary systems. In systems of cadmium(II) ions, *CMP* and diamines, only molecular complexes are formed, in which the polyamine is in the outer coordination sphere. In contrast to Cd(*CMP*)(H<sub>2</sub>tn) and Cd(*CMP*)(H<sub>2</sub>Put) compounds, in Cd(*CMP*)(H<sub>2</sub>en) species the phosphate group of nucleotide does not take part in the metallation, *i.e.* the metal ion coordinates with *CMP*, through the atom N(3) of the nucleotide, and the phosphate group is involved in non-covalent interactions with *en*.

## **Room Temperature Ionic Liquids – New Choline Derivatives**

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New room temperature ionic liquids – choline derivatives were prepared by Menshutkin reaction with alkyl chloromethyl ethers and anion changed to bis(trifluoromethylsulfonyl)amide ion. The newly obtained butoxymethyl(2-hydroxyethyl)dimethylammonium bis(trifluoromethanesulfonyl)amide was successfully tested as a solvent for *O*-acylation in two-phase reaction system. The ionic liquid-catalyst system was recycled and reused.

## Syntheses of 1-(Phenylsulfonyl)-(1*H*,3*H*)-imidazol-2-one Derivatives with Potential Biological Activity

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A series of 1-(arylsulfonyl)-3-(2,2-dimethoxyethyl)ureas (**2a–e**) was obtained by the reaction of 1-(phenylsulfonyl)ureas (**1a–e**) with aminoacetaldehyde dimethyl acetal in boiling dioxane. Cyclocondensation reactions of the 1-(arylsulfonyl)-3-(2,2-dimethoxyethyl)ureas (**2a–e**) in 98% H<sub>2</sub>SO<sub>4</sub> gave the appropriate 1-(arylsulfonyl)-(1*H*,3*H*)-imidazol-2-ones (**3a–e**) in good yields. The subsequent reaction of **3a** with methanesulfonyl- or 4-nitrophenylsulfonyl chlorides furnished the 3-(R<sup>4</sup>-sulfonyl) derivatives **4** and **5**, respectively. Preliminary screening data indicated that the compounds **3c–e**, **4** and **5** were inactive against three selected human tumor cell lines derived from Breast cancer (MCF7), Lung cancer (NCI-H460) and CNS cancer (SF-268).

## **Semi-Conductive Materials Based on the Titanium Dioxide Doped with Zinc: Catalytic Activity for Copper Deposition and Effect of UV-Irradiation**

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Novel semiconductive materials containing TiO<sub>2</sub> dispersion, doped with zinc and additional modifying salts of Cu<sup>2+</sup>, Fe<sup>2+</sup>, and Co<sup>2+</sup>, have been obtained. Such materials can be used as effective catalysts in the Cu<sup>2+</sup> reduction. Exposition to UV-light followed by the dark storage leads to complex changes of the catalytic activity of TiO<sub>2</sub> products. Detailed character of the changes depends on the presence of a doping agent and on the nature of modifying salts' anion. The scheme of the electron transfer processes has been proposed to describe changes of the activity.

## **The Double Layer Capacitance of the Liquid Lead Electrode in Molten NaX-KX (X = Cl, Br, I) Eutectic Mixtures**

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Using the Electrochemical Impedance Spectroscopy, the double layer capacitance of the liquid lead electrode in the molten NaX-KX eutectic mixture has been evaluated at several temperatures at the rest potential, and in the potential range from 0 to  $-1$  V against reversible lead electrode in the same melt. At no applied potential the liquid lead electrode in the studied eutectic melts can be treated as an “ideally polarizable” electrode. It has been found that the double layer capacitance at the rest potential is very small of the order of  $0.9 \mu\text{F cm}^{-2}$  for chloride,  $0.6$  for bromide and  $0.2 \mu\text{F cm}^{-2}$  for iodide melts. As expected its value is decreasing with the increase of the temperature. At the far negative end of the potential range ( $-1.0$  V), the double layer capacitance is decreased by the faradaic process (formation of the alkali metal – amalgam in liquid Pb). With the increase of the potential, the rate of this process decreases and the double layer capacitance increases. With a further increase of the potential, the alkali metal cations in the primary ionic shell are substituted by the halide anions, decreasing the charge density in the primary ionic shell, which results in the decrease of the capacitance toward some small value at the “potential of zero charge”. Still further increase of the potential creates a new double layer, composed mainly of halide ions and the charge density increase is accompanied by the increase of the double layer capacitance. When the anodic dissolution of the metallic lead starts, another decrease of the double layer capacitance is observed. The evaluated values are much lower than the previous results, obtained in early sixties of the 20-th century, which has been obtained by the neglecting of the frequency dependence of the measured capacitance.

## **Frequency Distribution of Chemical Oscillations in the Closed Belousov-Zhabotinsky Reaction**

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The potential registers of chemical oscillations, generated in the closed Belousov-Zhabotinsky reaction, have been submitted to detail spectral analysis using two algorithms based on the Fourier transform. It has been found that for selected stationary fragments of this signal the FFT algorithm distinctly reflects the strength of the spectral components contained in an exemplary potential register of BZ reaction. The temporal localization of these components is hidden in the phase of the spectrum, what makes the drawing of correct conclusions about the process investigated impossible. The cone-shape distribution, belonging to the group of joint time-frequency transformations, has been proposed as a proper method of nonstationary signals analysis. Spectrograms obtained by the above method have been presented, showing frequency evolution of chemical oscillations in time domain and their energy distribution simultaneously. Good reproducibility of spectrograms for potential registers of different time courses has been found. On the basis of harmonic components analysis the linear dependency between the frequency of harmonics and the composition of BZ reacting mixture has been noticed.

## **The Effect of Propanal on the Stability Range of the Reconstructed Au(100) Surface in Different Electrolytes**

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Voltammetric measurements have been employed to assess the effect of propanal on the stability range of the reconstructed Au(100) surface in different electrolytes. The results show that, depending on the type of anions, propanal reduces or increases or does not change the stability range of the reconstructed surface. The influence of the propanal electrooxidation on this stabilization is considered.

**Miscibility Isotope Effect in Ethylene  
Glycol – Nitromethane System**

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**Studies on Synthesis and Fluorescence Spectra  
of New Europium Complex with an Amide-Based  
Tripod-Type Compound**

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**Synthesis and Fluorescence Spectra of Europium(III)  
and Terbium(III) Complexes with  
a New Bis-Schiff Base Ligand N,N'-Bis(2,4-di-  
hydroxyacetonephenone)-2,6-diaminopyridine (H<sub>4</sub>L)**

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## **Nickel Hydride: Stroka-Baranowski Effect**

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