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Elena G Kovaleva

Ural Federal University, Russia

Electrical potential near hydrated solid surface by pH spin probes and labels

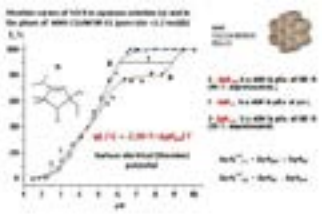
Statement of the Problem: Many solid-phase materials, for instance, porous and nano structural objects as well as the systems of specific functionality are widely used in aqueous solutions as promising heterogeneous catalysts of various reactions, can serve as suitable carriers for catalytically active organic and bioorganic groups and enzymes, and also be adsorbents of large and small molecules. The properties of solid-phase materials are affected therefore, both the chemical nature of the solution and some specific conditions are arising in the phase and on the surface of these materials. Surface electrical potential (SEP) is among the most important surface characteristics of these materials. At present, there is no method for measuring SEP of hydrated porous and nanostructured materials.

Aim: The aim of this study is to develop the method for measuring SEP of different solid phase hydrated materials by EPR of pH sensitive nitroxides (NR) as spin probes and labels.

Methodology & Theoretical Orientation: A variety of nitroxides with the range of pH-sensitivity from 2 to 8.5 pH were incorporated into nanoporous and nanostructured inorganic oxides as powders and membranes and a diversity of organo-inorganic hybride materials both by adsorption from aqueous solution and through covalent binding technique. pH-dependent parameters of EPR spectra were measured through monitoring pH in a bulk solution and inside materials.

Findings: The negative and positive values of stern potential for the positively and negatively charged surfaces were measured from the characteristic shifts of the EPR titration curves for the slow-motion NR located in the material near-surface about those for a bulk solution. Stern layer thickness for mesoporous silicas was determined from the near-surface electrical potential profile using a model of practically cylindrical nano sized hydrated channels of the mesoporous silicas with channel diameters ranging from 2.3 to 8.1 nm.

Conclusion & Significance: An unique technique for measuring the near-surface (Stern) potential as well as Stern layer thickness and surface charge based on EPR of pH-sensitive nitroxides as spin probes and labels have been developed for a wide range of hydrated porous and nanostructured materials with a great potential for adsorption processes and heterogeneous catalysis.



Biography

Elena G Kovaleva has her expertise in "Electro surface and electro capillary phenomena in inorganic nanoporous and nano sized systems, organo-inorganic hybride materials, ion-exchange resins by EPR of pH-sensitive nitroxide as spin probes and labels as well as other paramagnetic particles as Cu^{2+}, Co^{3+}, Mn^{2+}, Cr^{3+}". Recently, she developed the technique for determination of local acidity and near-surface potential in porous and nanostructured hydrated materials. She is currently working on the problem of the effect of electrostatic properties of a charged surface on catalytic activity heterogeneous catalysts carrying industrial enzymes.

e.g.kovaleva@urfu.ru