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Physicochemical Problems of Mineral Processing

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Preface

Phase boundary physicochemistry is an interdisciplinary branch of science on the borderline of physics and chemistry, whose main premise is to thoroughly investigate phenomena (chemical reactions) occurring at the interface of eg. solids, liquids or gases. The mechanism of the reactions themselves is the same, regardless of whether they occur on the surface or inside the substance. However, those reactions are strongly influenced by various surface phenomena, such as adsorption, adhesion, cohesion, desorption, surface electric charge accumulation, as well as phenomena occurring just above the surface, such as diffusion and flow. In turn, the surface structure itself has a strong influence on these phenomena. Hence, surface physicochemistry includes elements of both solid state physics and physical chemistry. The theoretical basis of all these phenomena are used in many fields of technology, ranging from heterogeneous catalysis, to the production of integrated circuits or fuel cells, and ending with the development of surfactants (paints, varnishes, adhesives). In addition, it should be noted that they are also of key importance in preventing corrosion. Surface physicochemistry is also strongly associated with materials science. Such situation is observed especially in case of functional materials, which can be utilized as active adsorbents, catalysts (photocatalysts), polymer fillers, components of biocomposites, carbon-based composites, electrode materials or substitutes of commonly used natural substances. The physicochemical properties of such systems mainly depend on the route of their synthesis and final treatment method (thermal treatment), and the fact that they are similar to physicochemical properties of naturally occurring systems confirms the possibility of their analogous application. Inorganic-inorganic or inorganic-organic hybrid materials are recently the most promising direction of studies focused on obtaining systems characterized by high quality and functionality. Depending on the needs, those materials may be synthesized using different methods, and the selection of an appropriate method determines their physicochemical properties, such as: morphology and dispersive character, electrokinetic and thermal stability, parameters of the porous structure, hydrophilic-hydrophobic nature. A broad spectrum of methods of synthesis allows to design hybrid materials characterized by diverse physicochemical and structural parameters, which is crucial in terms of the continuously increasing demand for such combinations. Each of the methods is characterized by advantages and disadvantages, and the selection of the appropriate one should be preceded by their detailed analysis. In particular, the considerations should include the economical aspect of the process, the possibility to its realization at laboratory as well as semi-technical scale, and the generation of waste substances. Another advantage is associated with the fact that the properties of such materials may be freely designed, by selection of the components which are included in the resulting products as well as by means of further treatment using different surface modifications with multifunctional organic or bioorganic substances. Mentioned technological procedures result in an enhanced activity of the synthesized materials, which is of great importance when considering their potential fields of application, among others in medical or environmental aspects, polymer or alloy processing and catalysis (photocatalysis).

The presented special issue deals with novel aspects and perspectives in metal oxide and hybrid materials fabrication. The contributions provide an overview of current research problems of both theoretical and experimental aspects and are mainly focused on the search for a new group of advanced materials with designed physicochemical properties, especially an expanded porous structure, and defined surface activity. Proposed technological procedures result in an enhanced activity of the synthesized hybrid materials, which is of great importance when considering their potential fields of application. The use of such materials in different technological disciplines, including aspects associated with environmental protection, allows for the verification of the proposed synthesis method. Thus, it can be stated that those aspects are of interdisciplinary character and may be located at the interface of

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three scientific disciplines – chemistry, materials science and engineering as well as environmental protection. What is more, presented scientific scopes are in some way an answer for continuously demand for such type of materials and opens new perspectives for their practical use.

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