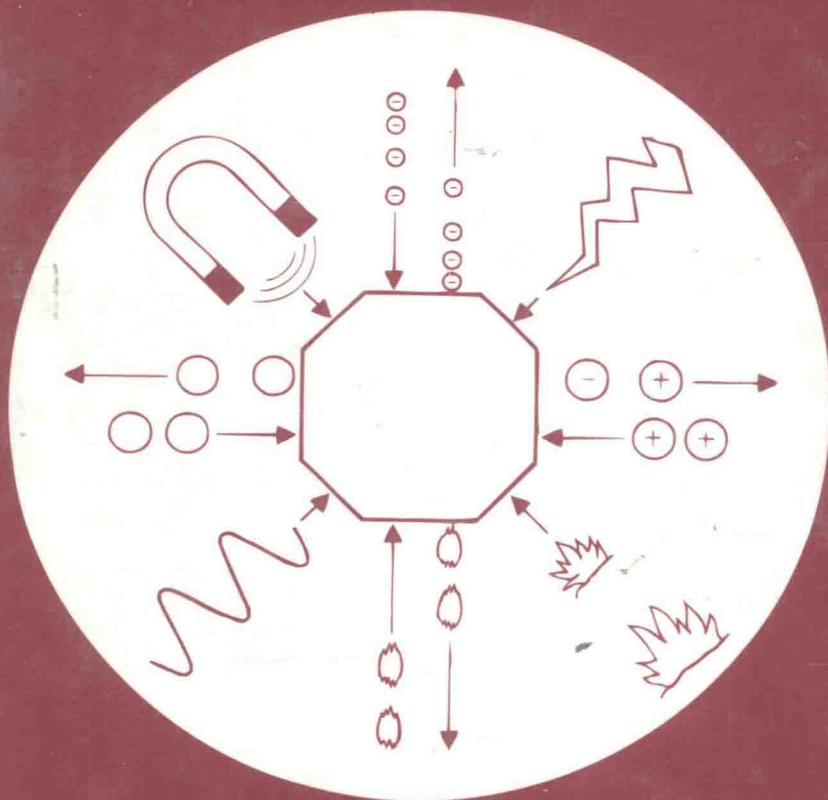


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99

ADSORPTION ON NEW AND MODIFIED INORGANIC SORBENTS

A. Dąbrowski
V.A. Tertykh
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PREFACE

A need for a profound book on adsorption and chemisorption on inorganic sorbents has existed for a long time. Justification for such a book results from the biological, environmental and technological importance of inorganic sorbents and significance of adsorption phenomena at the solid/gas as well as solid/liquid interfaces. The range of the work has been determined by the attributes of the above mentioned fields of science. As the themes to be considered refer to such a wide spectrum, no single author could write a critical review or paper on more than a very limited number of problems. That is why this book includes chapters written by authoritative specialists. We would like to present a study including papers and critical reviews describing theories and experiments, systems and methods used in the investigations and in many cases the examples of their applications. Moreover, we would like to point out problems and questions already solved but requiring further researches.

The sorbents discussed in this book are first of all synthetic mineral ones. Such materials as zeolites and organic carriers will not be considered as they have already been discussed in numerous monographs. Each contribution deals with a problem critically showing its development and presenting a summary of the latest results.

The book is divided into three sections consisting of chapters arranged in a consistent order, though some chapters could be put in the second or third section. On the other hand, a uniform treatment and style cannot be anticipated in the book that represents the efforts of many authors. Despite this, the presented works provide the comprehensive, high standard and modern study on the structure, investigations, preparation of inorganic sorbents, their numerous applications and deal with the adsorption on new and chemically modified inorganic solids.

Section I considers the methods of synthesis and physico-chemical properties of new types of inorganic sorbents (complex carbon-mineral sorbents, co-precipitated hydroxides, functional polysiloxane sorbents, porous glasses with controlled porosity, colloidal silicas, aluminium oxyhydroxide colloids, apatites). These sorbents are widely used in scientific investigations, in chemical practice and are important from a technological point of view. The presented results provide additional possibilities for the preparation of inorganic sorbents possessing unique adsorption and catalytic properties. Moreover, Section I presents the possibilities of the computational studies on the design of synthetic materials for selective adsorption of different substances.

By chemical modification of the oxide surfaces it has become possible to design new, reliable, highly-specified adsorbents, selective catalysts, polymer extenders, efficient thickeners of dispersive media. The interest in the modified oxides has increased for a few years as a result of favourable perspectives for their application for various kinds of the chromatographic separation, preparation of grafted metal complex catalysts, immobilized enzymes and other biologically active compounds. Introduction of the surface

modified silicas into practice of the high-performance liquid chromatography both in the reversed and normal phases was the most pronounced.

Section 1 presents the studies both on the structure of the formed surface compounds and the main regularities of the chemisorption processes and on kinetics of chemisorption from the gas phase on oxide surfaces. Prospective ways for the immobilization of different active compounds have been also proposed.

The next stage of the presented investigations shows the elaboration of the physico-chemical approaches for the quantitative prediction of the alternations in the properties of the compound after its chemisorption on the solid surface. This is important to improve the experimental possibilities for the characterization of the interactions of the active surface sites with the grafted compound. Moreover, it is necessary to take into account the influence of the residual structural hydroxyl groups practically always remaining modified oxide surface. The mutual influence of the neighbouring molecules anchored on the oxide surface should be taken into account as well. Elucidation of the chemical modification influence on the alterations in the porous structure of the oxide matrices, working out the principles of the mosaic surface modification for the creation of different sites on the surface and some practical objectives are of significant importance.

The principal aim of Sections 2 and 3 dealing with the adsorption from gaseous and liquid phases is to present various approaches for investigating the surface characteristics of inorganic sorbents. For this to reach the following methods have been presented:

- adsorption studies assuming the well-defined models of adsorption systems,
- calorimetric studies of adsorption phenomena,
- chromatographic studies for examining the surface properties of original and modified solid sorbents,
- experimental techniques, such as NMR techniques, X-ray analysis, IR spectra, etc.,

for measuring surface parameters, where this seems useful. Moreover, in many cases the calorimetric and apparatus techniques are discussed and related to the analysis of the adsorption investigations.

In Section 2 the phenomenon of the phase transitions in the layers adsorbed on solid sorbents is also discussed.

Section 3 presents the chapters both on adsorption from nonelectrolyte mixtures and on ion adsorption at the oxide/electrolyte interface. This interface is probably the most important in science, life and technology. Moreover, the ionic surfactant adsorption, mainly from aqueous solutions onto various inorganic sorbents has been considered.

It should be pointed out that only a few chapters of the book present the problems including carbonaceous sorbents. It results from the fact that (e.g. Chapter 2.10) the micropore filling mechanism for carbon porous sorbents is relatively well known and therefore this knowledge can be a basis for analogous considerations on inorganic sorbents. On the other hand, in Chapter 3.10 concerning the chromatography of fullerenes, the silicas with bonded fullerenes are used for the separation of organic compounds by the reversed phase liquid chromatography.

In some chapters of Sections 2 and 3 the adsorption and desorption kinetics is discussed in terms of the phenomena including inorganic sorbents.

Many areas in which technological novelty has involved this kind of substances and surface phenomena related to them, have been developed to be more of an art than science. From this point of view, understanding of the scientific backgrounds is very important for a large group of research workers both in academic institutes and industrial laboratories, whose professional activity is related to the fields of surface chemistry, inorganic chemistry, adsorption, ion-exchange, catalysis, chromatography and spectroscopy of the surface phenomena. This book is meant for the above mentioned potential readers and for the students of graduate and postgraduate courses.

It should be emphasized that each of 34 chapters gives not only brief, current knowledge about the studied problem but is also a source of topical literature on it. Thus, each chapter can constitute a literature guide for a given subject and encourage the reader to get to know a problem and develop the own studies in this exciting area of surface chemistry.

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Section 1

PREPARATION, STRUCTURE AND PROPERTIES OF NEW AND MODIFIED INORGANIC SORBENTS

