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Membrane-Mimetic Approach to Advanced Materials

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Editors

Preface

All creativity is an escape from the restraints of the conscious mind.
Arthur Koestler

The demand for advanced materials with superior mechanical, thermal, electrical, optical, magnetic, electro-optical, and electromagnetic properties is ever increasing. Most advanced materials, until recently, have been formed empirically by solid state methods. Further progress in the generation of advanced materials with preselected properties demands innovative chemical tailoring and, thus, a fundamental understanding of interactions and reactions at atomic, molecular, and supramolecular levels.

This contribution advocates a „wet" colloid-chemical approach, based on membrane-mimetic chemistry, to the preparation of advanced materials. Only the essential functions of the biological membrane - molecular organization, compartmentalization and discrimination - are imitated in membrane-mimetic chemistry. Membrane-like compartments are constructed and are employed in the in situ generation and stabilization of advanced materials. The membrane-mimetic approach is analogous to and inspired by biomineralization - the in vivo formation of inorganic crystals and/or amorphous particles in biological systems.

The importance of advanced materials and the rationale and philosophy of a membrane-mimetic approach to advanced materials are detailed in the Introduction. The Introduction also contains definitions of the terms used and the scope of the monograph. Preparation an characterization of the different membrane-mimetic compartments are described in the second section of the treatment. Merits and disadvantages of monolayers (Langmuir films), Langmuir-Blodgett (LB) films, self-assembled (SA) films, aqueous micelles, reversed micelles, micro-emulsions, surfactant vesicles, polymerized vesicles, polymeric vesicles, tubules, rods and related self-assembled structures, bilayer lipid membranes (BLMs), cast bilayers, polymers and polymeric membranes, zeolites, clays, porous glasses, and proteins are discussed in this section. The exploitation of these systems in the preparation of metallic catalytic particles, semiconductor particles and particulate films, conductors and superconductors, magnetic particles and particulate films, and advanced ceramic materials and their subsequent characterization and utilization are discussed in Sec. 3, 4, 5, 6, and 7, respectively. Ample references have been provided throughout this review to primary and secondary publications.

Decidated to my guiding spirit whose shadow I am.

Janos H. Fendler

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