

Preface to the Special Issue on the Formation of Composite Materials

Alexander Herega¹, José Ignacio Velasco²

¹Department of Computer Systems and Department of Physics, Odessa National Academy of Food Technologies, Ukraine

²Department of Materials Science and Metallurgy, Industrial and Aeronautic Engineering School, Universitat Politècnica de Catalunya, Terrassa, Spain

Research on the mutual influence of structure and properties of matter is a traditional topic of Materials Science. Considering a composite material as a complex system formed by different multi-scale structures, understanding their specific interactions extends the possibilities of useful structural changes in order to attain new characteristics to the composite.

Modern research has shown the essential role played by secondary phases in the properties of composites. Depending on their characteristics, these phases are known to substantially alter the transport properties of composites, such as electrical conductivity, their gas diffusion, determine their mechanical strength or corrosion resistance, and may lead to the occurrence of phase transitions and to important changes in other physical, chemical and mechanical properties.

One of the most interesting properties of solid matter is its continuous and spontaneous self-organization. The long-duration study of solids is associated with the notion of an idealized structure with a given number of well-defined defects. This hypothesis has been considered in the past in classical manuals (eg, by L. Landau, E. Lifshitz or N. Ashcroft, D. Mermin) as a way to study materials. Nevertheless, real materials, and particularly composites, are intrinsically imperfect. Despite the negative connotation behind the concept of “defect”, many important properties of solids are directly related to the control of their flaws. Also important is the study of the microstructural complexity and heterogeneity of composites, as resulting properties are related to a great extent to these characteristics. If a proposed model fails in predicting the properties of a given composite, it should be reformulated in order to take into account the features of the phenomenon.

The aim of this special issue is to show recent advances in the area of interdisciplinary research of composite materials. The papers included cover a range of theoretical and experimental studies about the structure and properties of composites, as well as composite structural modeling using theoretical, mathematical and computational methods.

Guest editors of this special issue on the “Formation of Composite Materials” hope that the considered papers can promote the exchange of ideas and rational debate between Materials Science researchers.