

Preface

The Advanced materials and composites are based on achievements of modern theoretical, experimental, and computational methods, which ensure research and development of numerous processing techniques. By using the last attainments of Material Science, Condensed Matter Physics, and Mechanics of Deformable Solids, novel materials and structures have found broad applications in modern science, techniques, and technologies working in ranges from nanoscale to macroscale. The continuous rise in requirements for improvement of material properties and extension of possibilities of devices, created on their base, support tremendous interest to fast development of the theoretical, experimental, and numerical methods. These methods allow us to obtain new knowledge and are capable to provide control and forecast on development of critical phenomena and improvement of very fine processes (for example, nanostructure and microstructure transformations during processing, loading, and working modern materials and composites in critical conditions, aggressive media, and wide types of physical and mechanical treatments). Practical applications demand from modern devices and constructions very high accuracy, reliability, longevity, and extended possibilities to work on broad temperature and pressure ranges. It is evident that the device characteristics are directly defined by used materials and composites opening new possibilities in the study of various physical processes, in particular transmission and receipt of signals under water.

This collection of 30 papers presents selected reports of the 2013 International Symposium on “Physics and Mechanics of New Materials and Underwater Applications” (PHENMA-2013), which took place in Kaohsiung, Taiwan, on June 5–8, 2013 (<http://phenma.math.sfn.edu.ru>) and was sponsored by the Russian Foundation for Basic Research, National Science Council of Taiwan, South Scientific Center of Russian Academy of Sciences, New Century Education Foundation (Taiwan), Ocean & Underwater Technology Association, Unity Opto Technology Co., EPOCH Energy Technology Corp., Fair Well Fishery Co., Formosa Plastics Co., Woen Jinn Harbor Engineering Co., Lorom Group, Longwell Co., Taiwan International Ports Co., Ltd.

The theme of the PHENMA-2013 and the Springer Proceedings continues the ideas of the previous symposium PMNM-2012 (<http://pmnm.math.rsu.ru>), whose results have been published in the edited book “Physics and Mechanics of New

Materials and Their Applications,” Ivan A. Parinov, Shun Hsyung-Chang (Eds.), Nova Science Publishers, New York, 2013, 444 p. ISBN: 978-1-62618-535-7.

The presented papers are divided into four scientific directions: (i) processing techniques of advanced materials, (ii) physics of advanced materials, (iii) mechanics of advanced materials, and (iv) applications of advanced materials.

Into framework of the first theme are considered, in particular, the nanotechnology approaches and novel methods in processing of a wide class of ferroelectric materials and multiferroics, preparation methods, and studies of ZnO nanorod arrays. Moreover, there are also presented investigations of $\text{Cu}_2\text{ZnSnS}_4$ solar cell materials manufactured on Mo/SLG substrates and processing technology of sapphire crystals. The first section ends by considering issues of optimization of the resin transfer molding process for curing large composite structures.

The second direction opens by theoretical studies of relations between domain states and phase contents in ferroelectrics, and also investigations of ferroelectric and magnetic phase transitions in multiferroics. Moreover, there are presented characteristics of Schottky tunneling barrier InP MOSFET and research results of the magnetic field effect on thermoelectric coefficient and Peltier factor in InSb.

From the viewpoint of mechanics are studied elastic and dissipative properties of solids on the base of finite-element modeling, and also piezo-excited Lamb waves in laminated composites. Moreover, there are studies of stress–strain state in layered anisotropic constructions at pulsed loading, problems of vibration acoustics of shells, and mechanical testing of polymeric composites for aircraft applications. The third section ends by investigations of interaction of the circular plate with elastic inhomogeneous layer and study of dependencies between displacements and elastic properties in solids of complex shape.

In the main, the presented applications are directly connected with underwater devices and issues of transmission and receipt of signals under water. In particular, the book discusses the study of underwater acoustic projector with active elements made from porous piezoceramics, digital frequency synthesizer for underwater systems, digital channels, and circuits for underwater communication including required models and algorithms. Other applied directions cover zinc oxide applications, investigations and use of cantilever-type piezoelectric generators, and closed axisymmetric shells.

The book is addressed to students, post-graduate students, scientists, and engineers taking part in R&D of nano-materials, ferro-piezoelectrics, and other advanced materials and composites presented in the book, and also in manufacture of different devices that have broad applications in different areas of modern science and technique, in particular in underwater communication.

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