Advanced Structured Materials

Volume 87

Common engineering materials reach in many applications their limits and new developments are required to fulfil increasing demands on engineering materials. The performance of materials can be increased by combining different materials to achieve better properties than a single constituent or by shaping the material or constituents in a specific structure. The interaction between material and structure may arise on different length scales, such as micro-, meso- or macroscale, and offers possible applications in quite diverse fields.

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Advances in Mechanics of Microstructured Media and Structures

Springer

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Preface

This volume is devoted to the memory of Russian scientist Eron Aero who passed away on June 2016. His outstanding contribution to the theory of materials with internal structure starts with his first publication with his supervisor Kuvshinsky on the model of the Cosserat continuum. It appeared in early sixties and attracted great attention of scientists as an outstanding contribution in the field of generalized continua. The main finding was the obtaining of the potential and the material relationships invariant to the rigid rotation while previous models were not invariant. Throughout his life, he considered the micropolar models of solids and fluids. Nowadays, the Cosserat continuum has taken a significant place in Continuum Mechanics among other generalized models of continua such as micromorphic continua, strain-gradient media and media with internal variables. His findings in the area inspired many scientists for their fruitful scientific researches.

He also contributed to the theory of liquid crystals developing new theory for nematics based on the use of couple stresses theory. He developed strongly nonlinear continuum theory of crystalline media whose complex lattice structure consists of two sub-lattices. He suggested a principle of translational symmetry that resulted in obtaining new nonlinear equations of motion. The solutions to these equations allow us to predict deep structural rearrangements of the lattice in the field of intensive power and thermal stresses: lowering of potential barriers, switching of the inter-atomic bonds, phase transitions, fragmentation of the lattice, etc; thus, some modern experimental data may be explained. The most important Aero's publications were listed in the editorial [V. A. Eremeyev, A. V. Porubov, L. Placidi. Special Issue in Honor of Eron L Aero. *Math. Mech. Solids*. 2016. **21**(1), 3–5].

As can be seen, E. Aero was not afraid to seriously change the direction of his research and distinguished by original approaches to the solution of the problems stated by him. His vivid non-standard thinking provided a great influence on the investigations of his colleagues who discussed their tasks with him.

This volume contains contributions of scientist dealing with various aspects of mechanics of microstructured media and structures. There are papers written by the colleagues of the Institute of Problems in Mechanical Engineering of the Russian Academy of Sciences where he worked for many years, organized and headed the laboratory of Micromechanics of Materials. In particular, these works concern development of the theory of highly nonlinear dynamic processes in media having complex crystalline lattice. Also the contributions on generalized microstructured media are presented which are originally inspired by his pioneering work with Kuvshinsky. The presented here papers address the further developments in the theory of Cosserat media, liquid crystals, porous media, piezoelectrics, thermodynamics, materials with surface stresses, in applications to the metamaterials and even in the modelling of the circumsolar ring evolution.

The volume continues honouring of achievements of E. Aero started by the Special Issue of the Mathematics and Mechanics of Solids (2016, SAGE Publ.) on the occasion of his 80th anniversary.

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