

Advanced Structured Materials

Volume 87

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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.

This book series addresses the fundamental relationship between materials and their structure on the overall properties (e.g. mechanical, thermal, chemical or magnetic etc.) and applications.

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- biomaterials
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- coated materials
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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.

Rome, Italy
Gdańsk, Poland
Saint Petersburg, Russia
November 2017

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Contents

Some Introductory and Historical Remarks on Mechanics of Microstructured Materials	1
Francesco dell’Isola and Victor A. Eremeyev	
Exact Analytical Solutions for Nonautonomic Nonlinear Klein-Fock-Gordon Equation	21
Eron L. Aero, A. N. Bulygin and Yu. V. Pavlov	
Percolation Threshold for Elastic Problems: Self-consistent Approach and Padé Approximants	35
Igor V. Andrianov, Galina A. Starushenko and Vladimir A. Gabrinets	
A 1D Continuum Model for Beams with Pantographic Microstructure: Asymptotic Micro-Macro Identification and Numerical Results	43
Emilio Barchiesi, Francesco dell’Isola, Marco Laudato, Luca Placidi and Pierre Seppecher	
Numerical Simulation of Energy Localization in Dynamic Materials	75
Mihhail Berezovski and Arkadi Berezovski	
Fracture Prediction of Piezoelectric Ceramic by the 2-D Boundary Element Analysis	85
M. Biglar, T. Trzepieciński and F. Stachowicz	
Rotational Waves in Microstructured Materials	103
Vladimir I. Erofeev and Igor S. Pavlov	
Localized Magnetoelastic Waves in a One and Two Dimensional Medium	125
Vladimir I. Erofeev and Alexey O. Malkhanov	

Waves in Elastic Reduced Cosserat Medium with Anisotropy in the Term Coupling Rotational and Translational Strains or in the Dynamic Term	143
Elena F. Grekova	
Modeling Stress-Affected Chemical Reactions in Solids—A Rational Mechanics Approach	157
Polina Grigoreva, Elena N. Vilchevskaya and Wolfgang H. Müller	
Structural Transformations of Material Under Dynamic Loading	185
D. A. Indeitsev, B. N. Semenov, D. Yu. Skubov and D. S. Vavilov	
One-Dimensional Heat Conduction and Entropy Production	197
A. M. Krivtsov, A. A. Sokolov, W. H. Müller and A. B. Freidin	
Model of Media with Conserved Dislocation. Special Cases: Cosserat Model, Aero-Kuvshinskii Media Model, Porous Media Model	215
S. A. Lurie, P. A. Belov and L. N. Rabinskiy	
Numerical Simulation of Circumsolar Ring Evolution	251
A. S. Murachev, D. V. Tsvetkov, E. M. Galimov and A. M. Krivtsov	
Two-Dimensional Modeling of Diatomic Lattice	263
A. V. Porubov	
Mechanics of Metamaterials: An Overview of Recent Developments	273
H. Reda, N. Karathanasopoulos, K. Elnady, J. F. Ganghoffer and H. Lakiss	
Acoustic Approximation of the Governing Equations of Liquid Crystals Under Weak Thermomechanical and Electrostatic Perturbations	297
Vladimir Sadovskii and Oxana Sadovskaya	
Effect of Surface Stresses on Stability of Elastic Circular Cylinder	343
Denis N. Sheydakov	
Spherically Symmetric Deformations of Micropolar Elastic Medium with Distributed Dislocations and Disclinations	357
Anastasia A. Zelenina and Leonid M. Zubov	