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Foreword

Frontiers of micro and nanomechanics of materials: Soft or amorphous matter, surface effects

The micromechanics of materials aims at establishing links between microstructural features of materials and their effective mechanical properties, ranging from elastic to nonlinear dissipative behaviour. The well-established methods developed in the past sixty years in this field of continuum mechanics are currently pushed to their limits in terms of length scale, material microstructure, and constitutive behaviour. Several homogenisation schemes have been extended to account for size effects exhibited by the material behaviour and induced by deformation mechanisms at the submicron or nanometre scale. Such extensions are possible for instance by means of the mechanics of generalised continua when resorting, e.g., to Cosserat and gradient theories at the upper or lower scales, or by considering the discrete nature of the underlying material's microstructure, like in polymer or fibrous materials. Size effects also arise from the surface and interface properties like energy or elasticity that can be incorporated in the continuum modelling of such media. The local properties of microstructured materials can be analysed by continuum approaches, discrete elements or molecular dynamics, by means of analytical or computational methods.

The nine contributed papers in this thematic issue tackle such problems at the frontiers of micro and nanomechanics. They have been selected among contributions to the Beijing–Paris Workshop on Micromechanics and Nanomechanics, which was held on 6–7 September 2012, at the Paris-East University in Marne-la-Vallée, France. This workshop aimed at presenting the advances in two huge cities with strong experience in mechanics of materials and at promoting cooperation between these teams. It was funded by the French Research Centre for Science (CNRS) through the "Fédération francilienne de mécanique" (F2M) and by the Labex MMCD "Multi-Scale Modelling and Experimentation of Materials for Sustainable Construction". The present papers are co-authored by French and Chinese researchers from prominent mechanics laboratories in Beijing and Paris. This thematic issue is the companion volume of Volume 29 of *Acta Mechanica Sinica*, published in December 2013, which contains four contributions from the workshop on similar topics.

Two contributions are concerned with the derivation of effective properties of lattice and networked materials relevant to engineering as well as biological applications. Another one explains that homogeneous equivalent media can be represented by Cosserat or gradient continuum models that involve mathematically investigated higher-order tensor properties. The large deformations and damage of elastomers are addressed by two papers investigating periodic cellular solids or randomly reinforced elastomers. Regarding metals, the mechanical behaviour of crystalline and amorphous materials is tackled in two articles. Finally, the treatment of biological materials requires additional ingredients like chemically induced shape polarisation and stochasticity of microstructure, as presented in two papers of this volume.

Samuel Forest *
Mines ParisTech CNRS, France

Quanshui Zheng
Tsinghua University, China

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* Corresponding author.

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