PREFACE

This special volume of *Computational Methods in Science and Technology* contains selected papers presented at the *Workshop on Auxetics and Related Systems* held during 27-30 June 2004 at Będlewo near Poznań, Poland. (Another set of papers will be published in the March issue of the *Physica Status Solidi b*. The complete information on the Workshop can be found at the address: http://www.ifmpan.poznan.pl/zp10/auxet/main.html). There were around 40 participants at the workshop from Poland, the United Kingdom, Japan, USA, Belarus, China, Denmark, Germany, Greece, Italy, Malta, Russia, Slovakia and Ukraine. We would like to gratefully acknowledge the support by the sponsors of the workshop (Centre of Excellence MMMFE, European Union 6th Framework Programme; Institute of Molecular Physics, Polish Academy of Sciences; State Committee for Scientific Research; UK EPSRC Auxetic Materials Network (AuxetNet)), the Scientific Committee, the Local Organising Committee and the referees.

Modern technology requires new materials of special properties. One of reasons for interest in materials of unusual mechanical properties comes from the fact that they can be used as matrices to form composites with other materials of other required properties: electric, magnetic, etc. A new field of endeavour are studies of materials exhibiting anomalous (negative) Poisson's ratio, first manufactured in 1987 (by R. S. Lakes) and later named (by K. E. Evans) *auxetics*, which, in contrast to typical materials (like rubber, glass, metals, etc.), expand transversely when pulled longitudinally and contract transversely when pushed longitudinally. This counterintuitive property is essential from the point of view of modern technology – many applications of the auxetics have been designed in various fields of human's activity, from vascular implants, strain sensors, shock and sound absorbers, "press-fit" fasteners, gaskets, air filters,... to fillings for highway joints. Materials containing inclusions of negative stiffness constitute another class of systems with unusual mechanical properties. The recent interest in such systems has its origin in their very high damping. Systems of extreme hardness, composites of hierarchical structures, polymers of negative thermal expansivity, and other materials of anomalous mechanical or structural properties, having a lot of potential applications, are also within the reach of the methods of modern science.

Analytical, computer, and experimental studies and modelling of such systems offer *better understanding* of known mechanisms responsible for their unusual properties and suggest *new mechanisms* which may lead to obtaining new materials of required features. Thus, investigations of the above non-conventional systems are interesting and important both from the point of view of fundamental research and from the point of view of possible practical applications.

The following topics, essential to the physics of auxetic and related materials, were within the scope of the Workshop:

1) properties and applications of auxetic materials,
2) mechanisms leading to auxetic behaviour,
3) experimental studies of auxetic materials,
4) multifunctional systems incorporating auxetic behaviour,
5) systems of special mechanical and/or structural properties (*e.g.* systems with inclusions of negative stiffness, composites of hierarchical structures, systems of extreme hardness, exotic liquid crystalline phases etc.),
6) theoretical and computer simulation methods for modelling auxetics and other systems of special mechanical and/or structural properties.

The main objective of the Workshop was to gather scientists (experimentalists and theoreticians) from various countries in one place to exchange information on new experimental and theoretical results and methods in the field of materials of unusual mechanical and/or structural properties. The Workshop was also addressed to young scientists (students, Ph.D. students and post-docs), with the aim of acquainting them with theoretical, experimental and simulation methods used in the physics of such systems.

We hope that exchange of information and ideas will not only lead to better understanding and exploiting of the already known systems but also to formulation of directions for new research activities which, in turn, will lead to discovering and/or manufacturing of new 'anomalous' systems.

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