

## Preface of the Editor

Nanocomposite materials constitute a rapidly evolving field of science and technology where the first applications are already on the market and many more are expected to follow. The admixture of relatively low amounts of nanoparticles (by definition any morphology having at least one dimension in the nano-range, i.e. particles, fibres, plates) in a matrix of polymer, ceramic or metal has dramatic increasing effects on the resulting properties (volume, surface and functional properties). Unusual property combinations can be realized, resulting in a new class of materials for almost every application.

Polymer nanocomposites are blends of different polymer matrices with nanometre sized functional particles. The properties of such polymer nanocomposites are also remarkably different compared to conventionally filled polymers. The incorporation of only a few percent of nanosized particles can make both dramatic property changes and formerly unachievable property combinations possible. Polymer materials reinforced with nanoscale components are therefore adding new dimensions to polymer composite materials and major improvements in functional and structural properties are within reach. Offering improved barrier properties, fire resistance, and strength, polymer nanocomposites are increasingly desirable as coating, structural, and packaging materials and are of great importance for a multitude of industrial uses in automotive, health care, electronics, aerospace, mechanical engineering, construction and building and consumer products with great economical and ecological benefits. This new technology constitutes a driving force for new employment opportunities in Europe.

Despite such property improvements and despite a large amount of research being undertaken in industry, research laboratories and universities, polymer nanocomposites is still a nascent field of materials science and technology which is in the development stage with tremendous potential growth prospects in the future.

But before these exciting prospects can be fulfilled, a large number of unresolved questions still need to be answered by science and technology: the understanding of the true nature of such composites, the interaction of the enormously large interface of the nanoparticles with the matrix, the composition/structure/processing/property relationship, the reproducible production routes, the making and source of nanoparticles, and questions on cost, health, sustainability and standardization.

At the EMRS fall meeting in Warsaw in September 2008 a symposium F on nanocomposite materials has been performed. This symposium has been organized within the framework of the COST Action

MP0701 on Polymer nanocomposites. It aimed to provide an overview of the various aspects of nanoparticle composites and thus to intensify the networking and cross-fertilization of ideas between the geographically distant groups working on nano-reinforced polymers, ceramics and metals.

Specifically, the various sessions performed within the 2008 EMRS symposium F have concentrated on the following scientific topics:

- Gaining a better understanding and control of the behaviour of the enormously large interfaces between nanosized particles and the matrix
- Methods for improved uniform dispersion and exfoliation at nanoscale
- Formation of controlled, patterned or hierarchical structures
- Developing advanced nanomechanical modelling and simulation tools
- Effective bonding of nanosized particles to the matrix
- Setting up novel improved processing methods for nanocomposite materials
- Process control to ensure reproducible results
- Developing cost-effective processing methods
- Elaborating, understanding and using the composition/process/property relationships
- Development of adapted or new characterization methods
- Utilizing new, alternative nanoparticles in nanocomposites.

Out of the approx. 100 oral and poster presentations given at the 2008 EMRS symposium F in Warsaw in September 2008 45 of them were selected in written form to be published in this special volume of "Solid state phenomena".

Erich Kny  
Chair of Symposium F, chair of COST Action MP0701  
Austrian Research Centers Seibersdorf (ARCS), Seibersdorf A-2444, Austria  
e-mail: [erich.kny@arcs.ac.at](mailto:erich.kny@arcs.ac.at)