

International Conference on  
**Advances in Polymer Science & Technology**

January 28-31, 2008  
India Habitat Centre, New Delhi, India



India Habitat Centre, New Delhi

Indian Institute of Technology, New Delhi

Conference Chairman

**Dr. Bhuvanesh Gupta**

Department of Textile Technology, Indian Institute of Technology, New Delhi-110016, India

Ph: +91-11-26591416, 26581061; +91-9871639232, Fax: +91-11-26581103, E-mail: [bgupta@textile.iitd.ernet.in](mailto:bgupta@textile.iitd.ernet.in)

## Abstract no PCNT-KN-1

### Hybrid and Nanocomposite Materials with Controlled Topologies and Unique Properties from Reactive Polymer Latex and Latex Blends

Valter Castelvetro, Sabrina Bianchi, Mario Mazzola

Department of Chemistry and Industrial Chemistry, University of Pisa, Pisa, Italy

Email: vetro@cci.unipi.it

#### Abstract

Polymeric materials and with outstanding surface and bulk properties such as exceptionally low surface energy, high mechanical strength and electroconducting behaviour among others, can be prepared as coatings or free-standing films by simple casting from water-borne dispersions of reactive or nanocomposite polymer particles as well as immiscible polymer latex blends with appropriate composition and dimensionality.

Control of the internal morphology and, in some cases, of the asymmetric orientation or non-uniform topological distribution of the nano-sized heterogeneous phase dispersed in, or intermixed with, the polymer matrix, may lead to unique and sometimes unexpected behaviour of the material. Specific surface and/or bulk properties can be tailored according to both the nature and the topological distribution of the dispersed phase. This polymer latex approach to the synthesis and design of nanostructured polymeric materials represents a viable, environmentally acceptable, simple and soft route to obtain true dispersions of mono-, bi- and three-dimensional nanoparticles in a polymer matrix. Representative examples of nanocomposite latex films based on layered silicates, carbon nanotubes (CNT), and spherical or spheroidal metal nanoparticles or other inorganic quantum dots are discussed.

Simple blending of a polymer latex with a carbon nanotube (CNT) aqueous dispersion allows to obtain, under appropriate conditions, a nanocomposite (NC) latex film with present extremely low electric percolation thresholds as a result of the peculiar topological distribution of the CNT nanowires within the polymer matrix. Non-percolative topologies are obtained if the NC latex precursor of the NC film is obtained by in situ miniemulsion polymerization starting from a dispersion of the CNTs in the comonomers. An accurate characterization of the dielectric properties of the NC films was carried out and the results correlated with the expected internal morphology of the material.[1]

The film-forming behaviour of dimensionally asymmetric blends of highly monodisperse high-Tg fluorinated and low-Tg unfluorinated acrylic latex particles are strongly influenced by particle size, particle size asymmetry (difference in particle size), and fractional volume composition.[2,3] Depending on the above parameters and on the ensuing packing arrangement, either the unfluorinated or the fluorinated latex particles become the dominant components of the heterogeneous film surface. As a consequence, different surface nanosized morphologies are generated and contact angles as high as 115° (higher than that of a reference fluorinated homopolymer) are observed for the blends based on the largest asymmetry ratio.[4]

Finally, a molecular approach to hybrid nanostructured latex-based materials is exemplified by the copolymers of reactive POSS derivatives (POSS = polyhedral oligosilsesquioxanes). Mono- and multifunctional POSS molecules are usually introduced in a polymer by copolymerization, melt or solution blending, in order to obtain hybrid materials with superior thermal, mechanical, optical and surface properties. Both monofunctional and octafunctional POSS-methacrylates were successfully dispersed in an acrylic matrix by by miniemulsion copolymerization, to obtain colloidally stable, film forming hybrid latex particles. The resulting hybrid latex films present quite different mechanical and surface properties as a result of the either free (monofunctional POSS) or hindered (polyfunctional POSS) mobility of the silica-like POSS nanocages.[5]

#### References

1. V. Castelvetro et al., "20th ISPAC - International Symposium on Polymer Analysis and Characterization", Heraklion, Grece, October 1-3, 2007
2. S. T. Eckersley et al., *J. Coat. Technol*, 1997, 69, 97
3. R. R. Thomas, K. G. Lloyd, K. M. Stika, M. S. El-Aasser, *Macromolecules*, 2000, 33, 8828
4. D. Scalarone et al., *Proceedings, "European Polymer Congress - EPF 2007"*, Portorož - Portorose, Slovenia, July 2- 6,2007
5. V. Castelvetro et al., *Macromol. Rapid Commun.* 2006, 27, 619