

## Multi-functional Aerogels and Novel Polymer Nanofibers

Sadhan C. Jana

Department of Polymer Engineering, University of Akron, OH 44325

The chemical and engineering issues associated with the development of multi-functional materials based on mesoporous aerogels and polymer nanofibers of unique morphology are discussed. Such materials are useful in a large number of applications such as separator materials of lithium-ion batteries, filter media for removal of airborne nanoparticles, and anti-bacterial wound dressing. The design of open mesoporous structures in aerogels with mechanically strong solid networks and the organization of two or more polymers in the same nanofibers in core-shell, bi-lobal, or interpenetrating network morphology are some of the key challenges that are answered by our research. Several specific examples will be presented to elaborate the concepts involved in the design of aerogels of silica, syndiotactic polystyrene, polyurea, and polyimides. The talk also covers the hydrodynamic aspects of a new, simple, and effective method for scalable production of polymer fibers ranging from a few tens of nanometers to a few micrometers from polymer solutions. The method capitalizes on a high velocity expanding gas jet to turn polymer solutions streaming from the nozzles into fibers with smooth or wrinkled fiber surface morphology and with core-shell, interpenetrating, and side-by-side arrangements. These fibers are converted into non-woven mats for potential use as wound dressing materials and as coalescing filters.

Selected references: Duan, Y., Jana, S.C., Reinsel, A.M., Lama, B., Espe, M.P., 2012 Surface modification and reinforcement of silica aerogels using polyhedral oligomeric silsesquioxanes. *Langmuir*, 28, 15362–15371; Benavides, R., Jana, S.C., Reneker, D.H. 2013 Role of liquid jet stretching and bending instability in nanofiber formation by gas jet method. *Macromolecules*, 46, 6081-6090; Benavides, R., Jana, S.C., Reneker, D.H. 2012 Nanofibers from scalable gas jet process. *ACS Macro Letters*, 1, 1032-1036.; Randall, J. P., Meador, M. A. B., Jana, S. C. 2011 Tailoring mechanical properties of aerogels for aerospace applications. *ACS Appl. Mater. Interfaces*, 3, 613-626; Wang, X., Jana, S.C. 2013 Tailoring of morphology and surface properties of syndiotactic polystyrene aerogels. *Langmuir*, 29, 5589-5598; Beltrán-Osuna, A.A., Cao, B., Cheng, G., Jana, S.C., Espe, M., Lama, B. 2012 New anti-fouling silica hydrogel. *Langmuir*, 28, 9700–9706.

**Biography:** Dr. Sadhan C. Jana is currently Professor of Department of Polymer Engineering at The University of Akron. He received Ph.D. degree in chemical engineering from Northwestern University in 1993, worked at General Electric Corporate Research Center for four years, and joined the University of Akron in 1998. Professor Jana served as chair of the department from 2004 to 2011. He was recognized by National Science Foundation with Faculty Early CAREER Award in 2002, by Indian Institute of Chemical Engineers with Chemcon Distinguished Speaker Award in 2005, by Society of Plastics Engineers (SPE) with Fred E. Schwab Award for outstanding achievements in education in 2010 and with William C. Zekan Memorial Service Award in 2011, and by National University of Colombia, Bogota with Honorary Professorship. He is a Fellow and Honored Service Member of The Society of Plastics Engineers (SPE) and serves as a member of the executive committee of Polymer Processing Society. He is editor-in-chief of Springer Materials: Polymer Section and is an associate editor of Polymer Engineering & Science. In addition, he serves in the editorial boards of a number of peer-reviewed journals.