

KADHIRAVAN SHANMUGANATHAN

Education

- **Doctor of Philosophy** in Macromolecular Science and Engineering
Case Western Reserve University
GPA: 3.8
Aug 2006- Mar 2010
Cleveland, OH
- **Master of Science** in Textile Chemistry
University of Massachusetts Dartmouth
GPA 3.81
July 2006
North Dartmouth, MA
- **Bachelor of Technology** in Textile Technology
Anna University
GPA 8.80/10.00
June 1999
Chennai, India

Research Profile

Graduate Research Assistant, (2006–present)

Case Western Reserve University (CWRU). Department of Macromolecular Science and Engineering
Working with an interdisciplinary team on an NIH funded project with primary focus on developing mechanically dynamic stimuli responsive nanocomposites for cortical probes.

- Prepared cellulose whisker nanocomposites that exhibited stimuli responsive dynamic mechanical properties and qualified as first generation materials suitable for further in vivo studies as substrates for cortical electrodes.
- Developing process protocols to get cellulose nanofibers from different sources like cotton and microcrystalline cellulose from plant cell wall and make mechanically strong nanocomposites with good dispersion of these nanofibers.
- Currently focusing on surface modification of these cellulose nanofibers to make functional composite materials with properties tailored for specific applications.
- Mentored four undergraduate students on small projects in 2007-2009.

Graduate Research Assistant, (2005–2006)

University of Massachusetts Dartmouth, Department of Materials and Textiles

Worked in collaboration with Civil and Environmental Engineering Department on a project to develop fibrous materials with ion exchange properties

- Prepared sulfonated polystyrene fibers and polystyrene coated glass fibers.
- Worked on solution electrospinning of polystyrene fibers to prepare nanofiber mats of polystyrene.

Graduate Research Assistant, (2003–2006)

University of Massachusetts Dartmouth, Department of Materials and Textiles

Worked in a National Textile Center funded project titled “Nano-engineered Fire Resistant Composite Fibers,” that aimed to obtain a fundamental understanding of the flame retardant mechanism of layered silicate nanocomposites and delineate the properties from films to fibers and fabrics.

- Optimized the process and prepared nylon 6- clay nanocomposites by melt mixing followed by extrusion of fibers using single screw extruder.

- Investigated the morphology of nanocomposites using wide angle x-ray diffraction and transmission electron microscopy and thermal properties by differential scanning calorimetry and thermogravimetric analysis.
- Investigated flame retardance behavior of nanocomposite films and fabrics using horizontal flame spread tester (FMVSS 302), cone calorimeter (ASTM E1354), and char analysis using Fourier transform infrared spectroscopy.
- Prepared drafts of annual reports submitted to National Textile Center for the years 2004 and 2005.

Industrial Work Experience

Engineer- Customer Support Department, Lakshmi Machine Works Ltd (LMW), India. (1999–2003)

New Product Development (2001-2003)

- Worked as cross-functional team member in new product development.
- Performed field evaluation of new products developed by Research & Development (R&D) department, attended cross-functional team meetings, and provided feedback/inputs on product performance and requirements.
- Coordinated with R&D in determining the procedure for installation and commissioning of pilot batch machines and preparation of installation/operating instructions manuals.

Technical Support (1999-2001)

- Accelerated complaint resolution process and resolved four long pending problems.
- Conducted onsite visits of over 100 clients for trouble-shooting problems related to performance of machines.
- Conducted training programs for delegates from Vietnam on technical and technological aspects of machinery and quality control measures and was rated as best trainer in trainer evaluation by the delegates.

Technical Skills

Familiar with the handling of following tools for analysis of polymeric materials.

Thermal analysis: Differential scanning calorimeter, Thermogravimetric analyzer.

Morphology analysis: Transmission electron microscope, Scanning electron microscope.

Mechanical analysis: Dynamic mechanical analyzer and Instron tensile tester.

Chemical structure analysis: Fourier transform infrared spectroscope.

List of Publications

1. Shanmuganathan, Kadiravan; Capadona, Jeffrey R.; Rowan, Stuart J.; Weder, Christoph. *Stimuli Responsive Mechanically-Adaptive Polymer Nanocomposites*. Manuscript submitted to ACS Applied Materials and Interfaces.
2. Shanmuganathan, Kadiravan; Capadona, Jeffrey R.; Rowan, Stuart J.; Weder, Christoph. *Bio-inspired Mechanically-Adaptive Nanocomposites Derived from Cotton Cellulose Whiskers*. Accepted for publication in Journal of Materials Chemistry.
3. Deodhar, Sarang; Shanmuganathan, Kadiravan; Dembsey, Nicholas A.; Fan, Qinguo; Wilkie, Charles; Costasche, Maurius C.; Patra, Prabir K., *Calcium Carbonate and Ammonium Polyphosphate based Flame Retardant Composition for Polypropylene*, Accepted for publication in Journal of Applied Polymer Science.
4. Shanmuganathan, Kadiravan; Capadona, Jeffrey R.; Rowan, Stuart J.; Weder, Christoph. *Biomimetic Mechanically Adaptive Nanocomposites*. Progress in Polymer Science (2009), In press.

5. Hess A.; Dunning J.; Harris J.P.; Capadona J.R.; Shanmuganathan K.; Rowan S. J.; Weder C.; Tyler D.J. and Zorman C.A., A Bio-Inspired Chemo-responsive Polymer Nanocomposite for Mechanically Dynamic Microsystems, IEEE Transducers 2009, M3P.051, Pg 224-227.
6. Capadona, Jeffrey R.; Shanmuganathan, Kadiravan; Trittschuh, Stephanie; Seidel, Scott; Rowan, Stuart J.; Weder, Christoph. *Polymer Nanocomposites with Nanowhiskers Isolated from Microcrystalline Cellulose*. Biomacromolecules (2009), 10(4), 712-716.
7. Shanmuganathan, Kadiravan; Deodhar, Sarang; Dembsey, Nicholas A.; Fan, Qinguo; Patra, Prabir K. *Condensed-phase Flame Retardation in Nylon 6-layered Silicate Nanocomposites: Films, Fibers, and Fabrics*. Polymer Engineering and Science (2008), 48(4), 662-675.
8. Shanmuganathan, Kadiravan; Capadona, Jeffrey R.; Tyler, Dustin J.; Rowan, Stuart J.; Weder, Christoph. *Stimuli-responsive Mechanically Dynamic Polymer Nanocomposites*. Polymer Preprints (American Chemical Society, Division of Polymer Chemistry) (2008), 49(1), 1073.
9. Capadona, Jeffrey R.; Shanmuganathan, Kadiravan; Tyler, Dustin J.; Rowan, Stuart J.; Weder, Christoph. *Stimuli-Responsive Polymer Nanocomposites Inspired by the Sea Cucumber Dermis*. Science (Washington, DC, United States) (2008), 319(5868), 1370-1374.
This research work has been highlighted in several news reports across the globe (*New York Times*, *BBC news*, *Telegraph*, *MSNBC*, *Yahoo India*, *Sydney Morning Herald*, *Reuters_Africa*, *MSN-France*. Copies of news reports enclosed).
10. Shanmuganathan, Kadiravan; Deodhar, Sarang; Dembsey, Nicholas; Fan, Qinguo; Calvert, Paul D.; Warner, Steven B.; Patra, Prabir K. *Flame Retardancy and Char Microstructure of Nylon-6/layered Silicate Nanocomposites*. Journal of Applied Polymer Science (2007), 104(3), 1540-1550. **(This article was featured with a cover picture).**
11. Shanmuganathan, Kadiravan; Razdan, Sandeep; Dembsey, Nick; Fan, Qinguo; Kim, Yong K.; Calvert, Paul D.; Warner, Steven B.; Patra, Prabir K., *Fire Retardancy and Morphology of Nylon 6-clay Nanocomposite Compositions*. Materials Research Society Symposium Proceedings (2006), 887 (Degradation Processes in Nanostructured Materials), 79-91.
12. Shanmuganathan, K.; Deodhar, S.; Razdan, S.; Fan, Q.; Calvert, P. D.; Warner, S. B.; Patra, P. K., *Flame Retardancy and Microstructure of Nylon 6/layered Silicate Nanocomposites*. Proceedings of the American Society for Composites, Technical Conference (2005), 20th 86/1-86/15.

Conference Presentations

1. Shanmuganathan, Kadiravan; Weder, Christoph; Rowan, Stuart J.; Capadona, Jeffrey R.; Dustin Tyler J., *Stimuli Responsive Mechanically Dynamic Polymer Nanocomposites*. Poster presented at ACS Summer School on Green Chemistry and Sustainability, Denver CO, July 27-28 (2009).
2. Shanmuganathan, Kadiravan; Weder, Christoph; Rowan, Stuart J.; Capadona, Jeffrey R.; Dustin Tyler J., *Stimuli Responsive Mechanically Dynamic Polymer Nanocomposites*. Poster presented at Research Showcase, Case Western Reserve University, Cleveland OH, April 10-11 (2009).
3. Shanmuganathan, Kadiravan; Weder, Christoph; Rowan, Stuart J.; Capadona, Jeffrey R.; Dustin Tyler J., *Stimuli Responsive Mechanically Dynamic Polymer Nanocomposites*. Poster presented at PolyImpact Northeast Ohio symposium, CWRU, Cleveland OH, June (2008). **Received first prize (\$500) for best poster in the symposium.**
4. Shanmuganathan K.; Capadona J.R.; Tyler D.J.; Rowan S. J.; and Weder C., Poster presented at American Chemical Society: National Meeting; New Orleans, LA, April 6-10 (2008).
5. Shanmuganathan, K.; Deodhar, S.; Razdan, S.; Fan, Q.; Calvert, P. D.; Warner, S. B.; Patra, P. K. *Flame Retardancy and Microstructure of Nylon 6/layered Silicate Nanocomposites*. 20th Technical Conference of American Society for Composites, Philadelphia, PA, September 2005.

6. Shanmuganathan, Kadiravan; Patra, Prabir K.; Deodhar, Sarang; Dembsey, Nicholas A.; Warner, Steven B.; Calvert, Paul D.; Fan, Qinguo. “*Nano-engineered Fire Resistant Composite Fibers.*” poster presented at 6th National Graduate Research Polymer Conference, University Of Massachusetts Amherst, June 2005.
7. Shanmuganathan, Kadiravan; Patra, Prabir K.; Deodhar, Sarang; Dembsey, Nicholas A.; Warner, Steven B.; Calvert, Paul D.; Fan, Qinguo. “*Nano-engineered Fire Resistant Composite Fibers.*” poster presented at Annual Conference of National Textile Center, Raleigh, NC. March 2005.
8. Shanmuganathan, Kadiravan; Patra, Prabir K.; Deodhar, Sarang; Dembsey, Nicholas A.; Warner, Steven B.; Calvert, Paul D.; Fan, Qinguo. “*Structure and Properties of Nylon 6/Montmorillonite Nanocomposite Fibers.*” poster presented at Materials Research Society Fall Symposium, Boston, MA, November 2004.

Patents

- Utility patent application filed on “Stimuli Responsive Polymer Nanocomposites”

Honors & Activities

- Received sponsorship from American Chemical Society to attend summer school on “Green Chemistry and Sustainability” (July 22-30), Golden, CO.
- Received from Case Western Reserve University, Ohio Innovation Incentive Fellowship for 2007-2009
- Received first prize in poster competition in PolyImpact Northeast Ohio (PINO) symposium in 2008.
- Received from Lakshmi Machine Works Ltd, Kaizen award for cost reduction suggestions.
- Received state scholarship for undergraduate studies by maintaining excellent academic standing.
- Student member of American Chemical Society (2007-09).
- Student member of Materials Research Society (2004-06).