

NIHAL KANBARGI

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RESEARCH INTERESTS

Characterization and structure-process-property determination of anisotropic polymers, cellular materials & composites
Supercritical fluid processing of cellular materials and composites
Probing molecular dynamics with solid state NMR
Mechanics of polymers blends, composites, cellular materials; failure analysis
Theoretical modeling of composites, adhesion

EDUCATION

University of Massachusetts Amherst | Amherst, MA (2017)

Ph.D. Polymer Science and Engineering

Thesis: Engineering Next Generation Anisotropic Materials and Composites

Advisor: Alan J. Lesser

University of Massachusetts Amherst | Amherst, MA (2013)

M.S. Polymer Science and Engineering

Indian Institute of Technology Roorkee | Uttarakhand, India (2012)

Integrated M. Tech Polymer Science and Technology (Polymer Rheology)

Thesis: Rheological Modeling of Complex Fluids under Simple Stress States

RELEVANT SKILLS AND TRAINING

Polymer Processing: Supercritical fluid processing of foams and composites, extrusion, melt thermoforming

Mechanical and Adhesion testing/Modeling: Tension, Compression, Flexural, DMA, Adhesion, Fracture

Toughness, Failure Analysis, Modeling Composite Systems

Rheology: Oscillatory, Capillary, Modeling of Fluid Flow

Microscopy: SEM, EDX, OM, AFM

Spectroscopy: Solid State NMR, FTIR

Thermal Analysis: DSC, TGA, DMA

X-Ray scattering: SAXS, WAXS

Programming: MATLAB, LabVIEW

TECHNICAL EXPERIENCE

Graduate Research Assistant

(2013-present)

Advisor: Alan J. Lesser, *University of Massachusetts Amherst*, Amherst MA

Modifying Composite Interphase and Theoretical Modeling of Adhesion-Bridgestone Americas

- Improved mechanical performance of Kevlar® (PPTA)-natural rubber composites by a combination of pre-treatments, microwave and mechanical, and coupling agents (vinyl siloxane and divinyl benzene) to improve interfacial adhesion
- Mechanical interlocking was obtained by creating fiber morphology and increasing 'interphase' stiffness
- Improved interfacial adhesion (van der Waals) between PPTA & natural rubber by more than 100%
- Failure analysis revealed change of failure modes from adhesive to cohesive
- Carried out modeling of interfacial adhesion, proposed a two-stage shear-lag model to account for interphase region in composites. Validated model in epoxy systems using photoelastic techniques (*PATENTED, PUBLISHED*)

Accelerated Aging Studies of Zylon® (PBO) Fibers with Solid State NMR - US Army Research Labs

- Probed degradation mechanisms in Zylon® (poly(*p*-phenylene-2,6-benzobisoxazole)) fibers using ³¹P and ¹H solid state Nuclear Magnetic Resonance (ssNMR)
- Utilized advanced pulse sequences to determine the physical state of residual phosphorus compounds present in fiber, finding a co-relation between environmental aging to the physical state of phosphorus compounds
- Confirmed hydrolytic degradation mechanism, proposed solutions to mitigate this problem (*PUBLISHED*)

Composite Microcellular Foams from Anisotropic Templates-BASF

- Fabricated composite foams with novel cell architectures utilizing scCO₂ as a processing and transport media to introduce a second phase into semi-crystalline anisotropic polymer templates to create kinetically trapped blends
- Biaxial and radial gradient morphologies were observed in PET/PS and PA12/PS blends, potential applications include turbine blades for wind energy generation, replacing balsa wood
- Explored the use of additives eg. Surfactants for efficient processing/extrusion of polyolefins, polyamides etc. at significantly lower temperatures (*PUBLICATION SUBMITTED*)

Research Assistant

(Jan-April 2012)

Department of Complex Fluids and Polymer Engineering, National Chemical Laboratory, Pune, India.

Rheological modeling and characterization of complex fluids under simple stress states

Research Assistant

(June-August 2011)

Nano-crystalline Materials Department, Center for Materials for Electronic Technology, Pune, India.

Selective-control hydrothermal synthesis of silver vanadium oxide-conducting polymer nanotubes.

Research Assistant

(June-August 2010)

Department Matériaux, École Catholique d'Arts et Métiers, Lyon, France

Rheological characterization and optimization of the sintering step of the powder injection molding (PIM) process

HONORS

Travel Award, SPE Ananda Chatterjee Honorable Mention (2017)

Indian Institute of Technology (IIT), Roorkee Department rank- 2nd (2012)

Scholarship, IIT-Roorkee Heritage Foundation for excellent academic and extra-curricular performance (2009)

PATENTS

Kanbargi, N., Lesser, A.J., Zhao, W., Agarwal, S., Mindaugas, R.: Treatment Methods for Modification of Aramid Fibers (PCT/US2016/047539)

PUBLICATIONS

- 1) **Kanbargi, Nihal**, Weiguo Hu, and Alan J. Lesser. "Degradation mechanism of poly (p-phenylene-2, 6-benzobisoxazole) fibers by 31 P solid-state NMR." *Polymer Degradation and Stability* 136 (2017): 131-138
- 2) **Kanbargi, Nihal**, and Alan J. Lesser. "Improving adhesion between aramid fibers and natural rubber through morphological and synthetic modification of the fibers." *Journal of Applied Polymer Science*, 2017
- 3) **Kanbargi, Nihal**, Marco Van Erp, Alan J. Lesser. "Composite Foams from Anisotropic Semi-Crystalline Polymer Templates" submitted
- 4) Md Arif Rahman, **Kanbargi, Nihal** Alan J. Lesser. "Processing Polyolefin Foams with Superheated Water and Surfactants" submitted
- 5) Diggikar, Rahul, Vishal Dhavale, **Nihal Kanbargi**, Milind V. Kulkarni, B. B. Kale. "Morphology controlled synthesis of LiV₂O₅/Ag nanocomposite nanotubes with enhanced electrochemical performance." *RSC Adv.* 2, no. 8 (2012)

SELECTED PRESENTATIONS

CUMIRP Spring Polymer Event, Amherst, MA May 2017

Modeling interfacial Adhesion in Composites using Shear Lag Models

Society of Plastics Engineers ANTEC, Anaheim, CA May 2017

Cellular Structures from Anisotropic Semi-Crystalline Polymer Templates

CUMIRP Fall Polymer Event, Amherst, MA October 2016

Long term aging of high performance PBO fibers using Solid State NMR.

Society of Plastics Engineers ANTEC, Indianapolis, IN May 2016

New treatments and modifications on Kevlar fibers

CUMIRP Spring Polymer Event, Amherst, MA May 2016

Engineering Anisotropic and Composite Foams using Supercritical Carbon Dioxide

American Chemical Society, Boston MA August 2015

Kevlar Composites: Improving adhesion using ScCO₂

OTHER SKILLS AND ACTIVITIES

- **Graduate Teaching Assistant**, Mechanical Properties of Polymers, Polymer Science & Engineering, UMass (2015)
- **Thermal Lab Facility Manager**, Polymer Science & Engineering, UMass Amherst (2015-2017)
- **Mechanical Testing Lab Manager**, Polymer Science & Engineering, UMass Amherst (2013-2017)
- **Mentoring Committee Leader**, Polymer Science & Engineering, UMass Amherst (2013-2014)
- **Mentor**, master's student (TU Eindhoven) (January-April 2016)
- **Treasurer**, Indian Student Association (ISA), a Graduate Student Organization (GSO), UMass Amherst (2013-2014)
- **Aspire and Outreach volunteer**, undertaking activities in schools to spark an interest in STEM fields (2013-2016)
- **Languages**: English, German (minimal reading, conversation), Hindi, Marathi