



RESEARCH PORTFOLIO

Clemson University Department of Materials Science and Engineering



Department of
**MATERIALS SCIENCE
AND ENGINEERING**

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The Materials Science and Engineering faculty are active in innovative research across all areas of Materials Science and Engineering, an interdisciplinary field. We have 23 faculty with research labs on the main campus and the nearby Advanced Materials Research Laboratory. All research groups have broad collaborations--with industry, national labs, and universities around the world.

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Areas of Expertise-

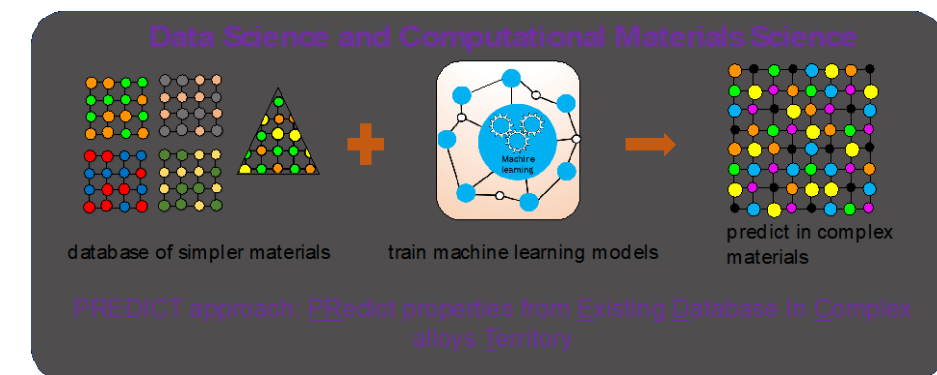
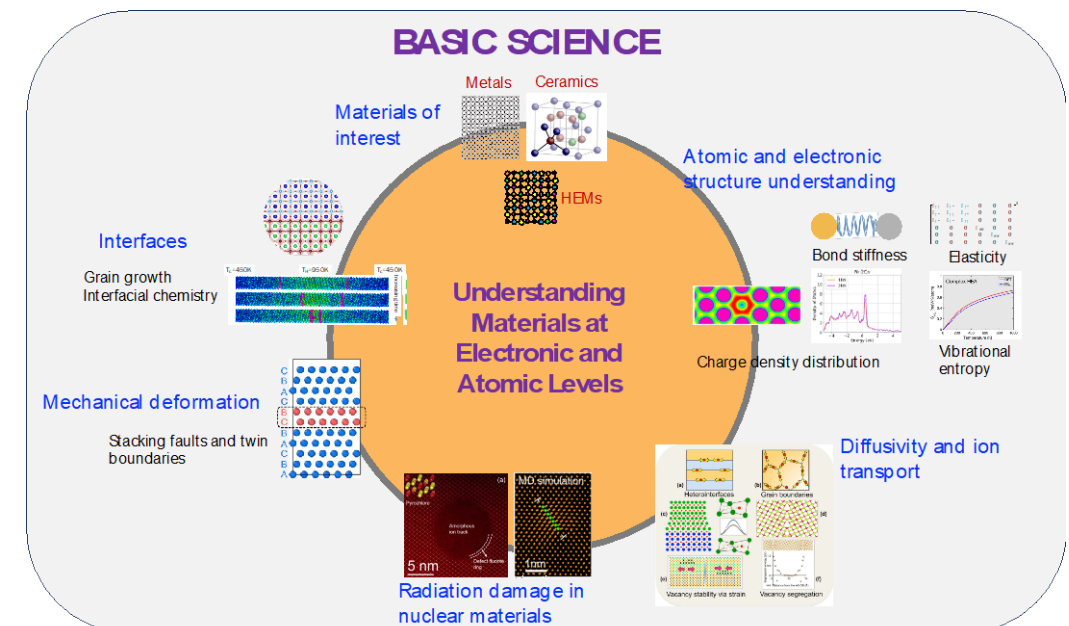
- Integrated Computational Materials Science and Data Science
- DFT, MD simulations and Machine learning
- High entropy materials
- Metallic alloys and ceramic oxides
- Mechanical, thermodynamic and kinetics, radiation damage, microstructure evolution

Recent Collaborations -

- NSF-DMR CDSE: Charge-density based ML framework for efficient exploration and property predictions in the large phase space of concentrated materials
- DOE-BES EPSCoR: Understanding twinning and deformation in high entropy alloys
- NSF track IV: Controlling Point-Defect Energetics in Complex Oxides Via Interfacial Strain

Publications -

- N. Linton and D.S Aidhy, A Machine learning framework for elastic constants predictions in multi-principal element alloys, *APL Machine Learning*, 1, 016109, (2023)
- G. Arora, S. Kamrava, P. Tahmasebi, D. S. Aidhy, Charge-density based convolutional neural networks for stacking fault energy prediction in concentrated alloys, *Materialia*, 26, 101620 (2022)



JOHN BALLATO <https://cecas.clemson.edu/ballato>

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Areas of Expertise -

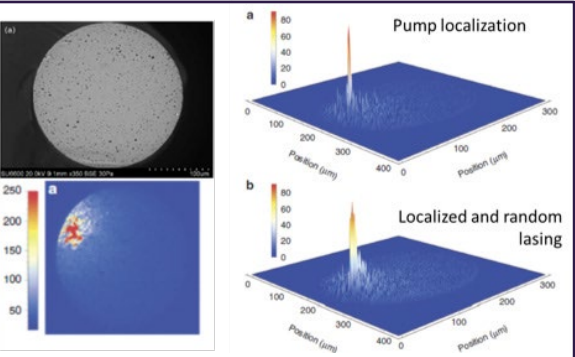
- Optical materials
- Glass
- (Real) fiber fabrication
- Lasers

Recent Projects -

- DoD: A Unified Materials Approach to Mitigating Nonlinearities in HEL Optical Fibers
- DoD MURI: Internal Cooling of Fiber and Disc Lasers by Radiation Balancing and other Optical or Phonon Processes

Publications/Patents -

- "Post-2000 nonlinear optics: Data tables and best practices," *Journal of Physics: Photonics* **5**, 035001 (2023). **Invited Review**.
- "Glass for photonics," *European Physical Journal Plus* **138**, 858 (2023).
- "Prospects and challenges for all-optical thermal management of fiber lasers," *Journal of Physics D: Applied Physics* **57**, 162001 (2023); **Invited Perspective**.
- "Semiconductor core fibres: a scalable platform for nonlinear photonics," *NPJ Nanophotonics* **1**, 21 (2024). **Invited Review**.

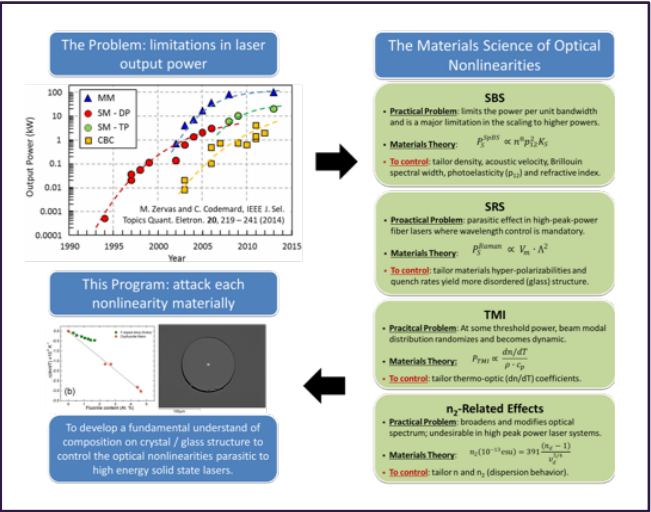


Novel fibers, fiber structures, and fiber materials
e.g., Anderson localization; and random lasing



Novel fibers, fiber structures, and fiber materials
e.g., Semiconductors, in-fiber semiconductor structures

Materials science of optical nonlinearities
Leverage our Group's unique combination of expertise in optical materials science and fiber formation / engineering to address the biggest problems plaguing fiber laser systems through materials development



VINCENT BLOUIN <https://cecas.clemson.edu/blouin>

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Areas of Expertise -

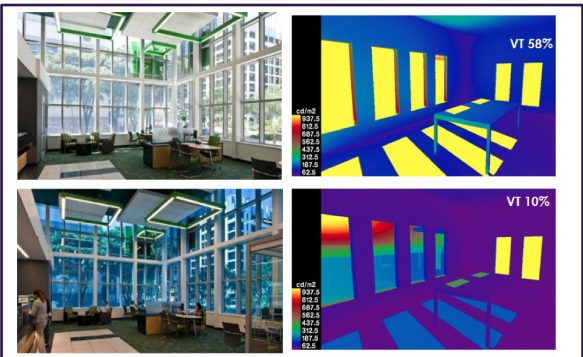
- Sustainability of the built environment
- Integration of smart materials and technologies in buildings

Recent Projects -

- Usability of electrochromic glazing in commercial buildings for visual comfort and energy consumption
- Thermodynamics of closed-loop geothermal system

Publications/Patents -

- Nikyema, VBlouin, "Barriers to adoption of green building materials and technologies in developing countries: The case of Burkina Faso," SBE19, Thessaloniki, Oct 2019
- MHamidpour, VBlouin, "Development of a Comparison-Based Control Strategy of Electrochromic Glazing for the Management of Indoor Lighting and Energy Efficiency," SimBuild, Chicago, Sept 2018
- NWonoto, VBlouin, "Using Grounded Theory for the Development of a Structural Optimization Tool as a Form-Finding Method for Architectural Schematic Design," JArch Eng & Tech, Vol 7(1), 2018
- DAlbright et al, Building Framing System, CURF, Patent No US 1,156,67 B2, Dec 2018



Electrochromic Glazing
Develop and test a new performance-based control strategy to optimize trade-off between visual comfort, energy consumption and usability



Thermodynamics of Geothermal Systems
Numerical simulation and experimental testing of coaxial heat exchangers enhanced with turbulators (vortex generators)



Patented Building Construction System: Sim[PLY]
CNC-cut plywood assembled as 3D puzzle held in place with metal zip ties

RAJENDRA BORDIA scepscoridea.org/MADEinSC/about MADEinSC.html

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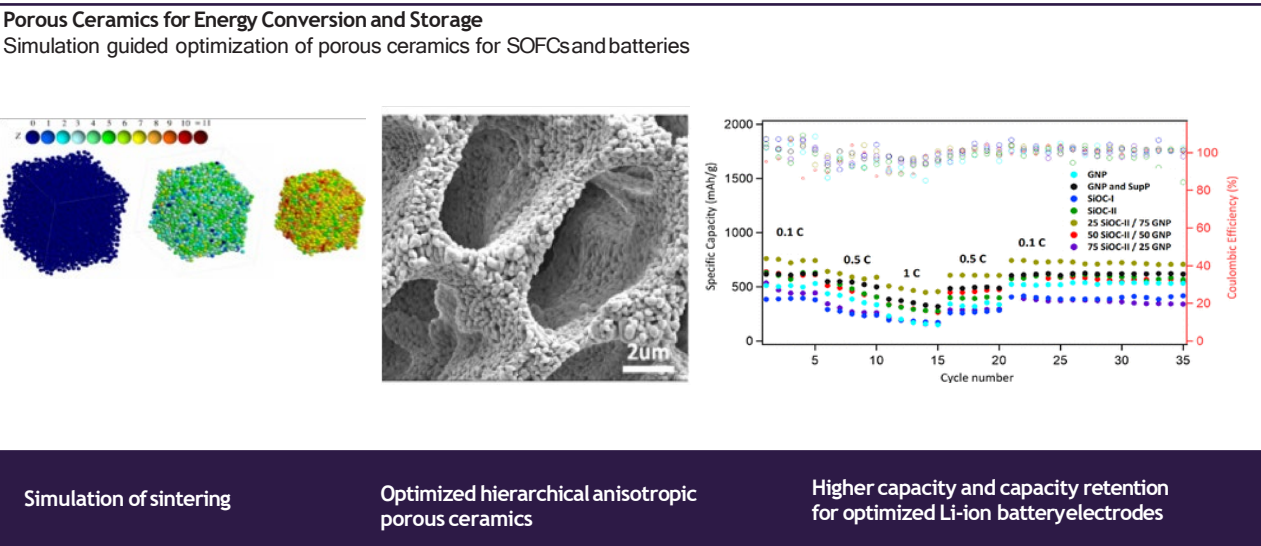
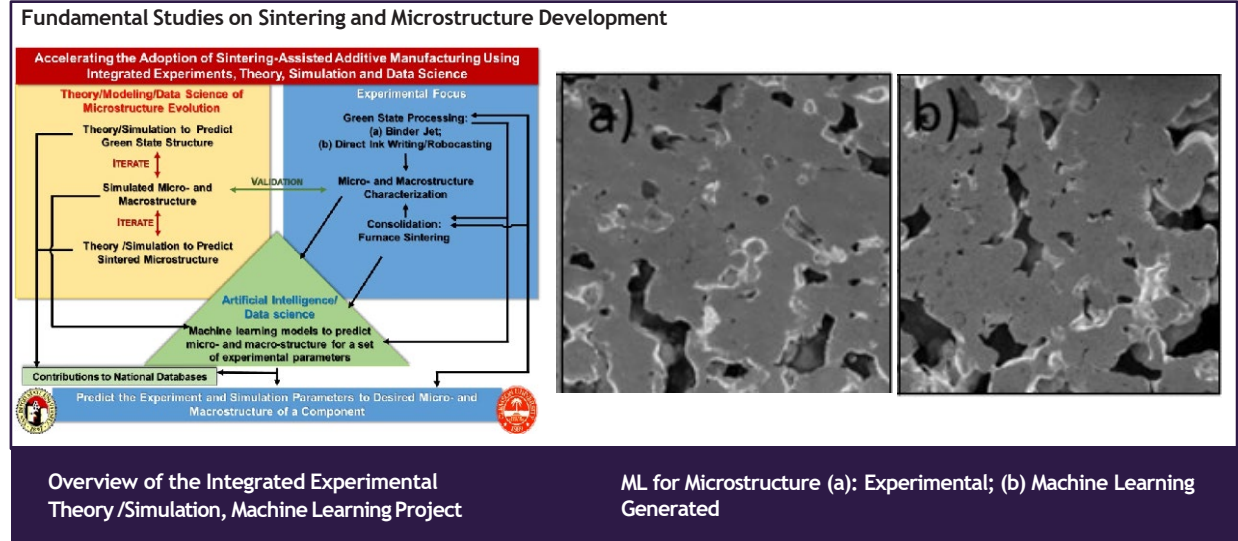
- Materials and Mechanics
- Microstructure Optimization
- Ceramics for Energy Conversion and Storage, and Extreme Environments

Recent Projects -

- AFRL: High-Temperature Ceramic Matrix Composites - Processing, Characterization and Properties
- Army: All Solid State High Energy Density Batteries for Extreme Environment
- NSF: Investigation of Sintering Anisotropy - Integrated Experimental, Theory/Simulation and Machine Learning

Publications/Patents -

- A. C. Rios, E. Olevksy, E. Hryha, M. Persson and R. K. Bordia Acta Materialia, 249 118822 (2023)
- Jella, Panda, Sapkota, Greenough, Datta, Rao, Sujith, and Bordia, ACS Applied Materials and Interfaces 15 [25] (2023)
- R. Sujith, G. Jella, M. Greenough, R.K. Boordia and D.K. Panda, Journal of Materials Chemistry A 11 20324 (2023)
- K.G. Webber, O. Clemens, V. Buscaglia, B. Malic, R.K. Bordia, T. Fey and U. Eckstein Journal of European Ceramic Society (2024)



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Areas of Expertise-

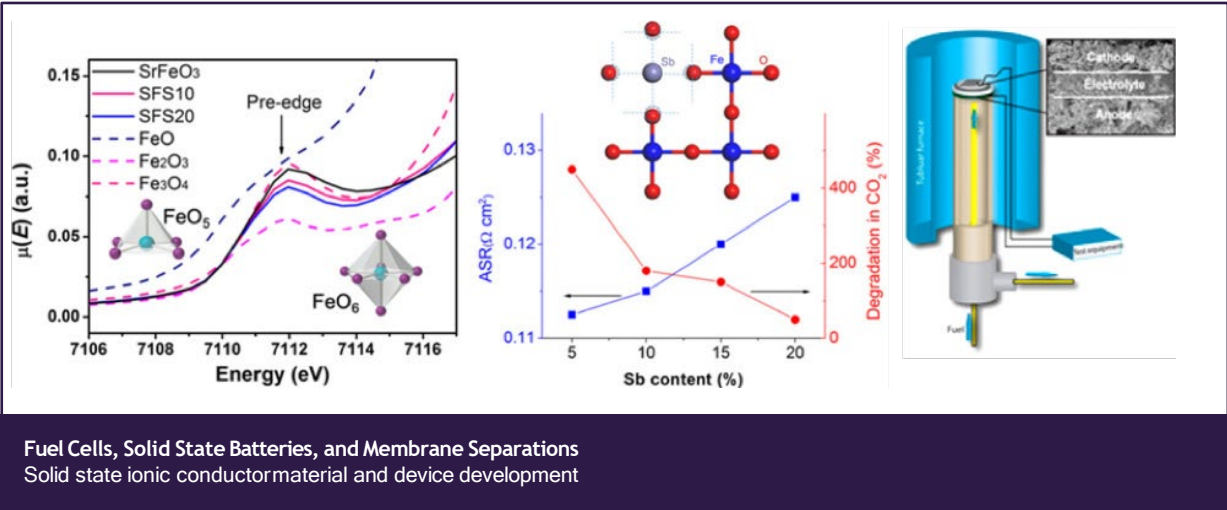
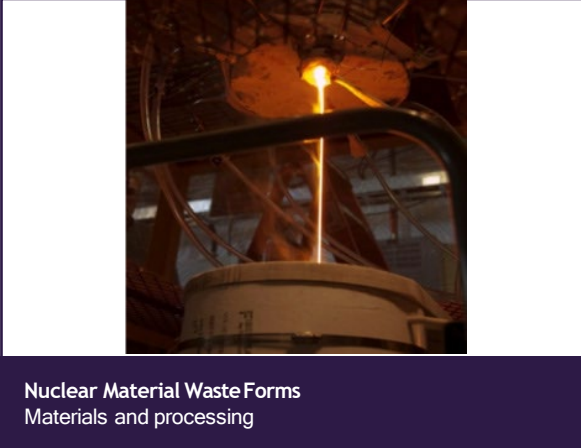
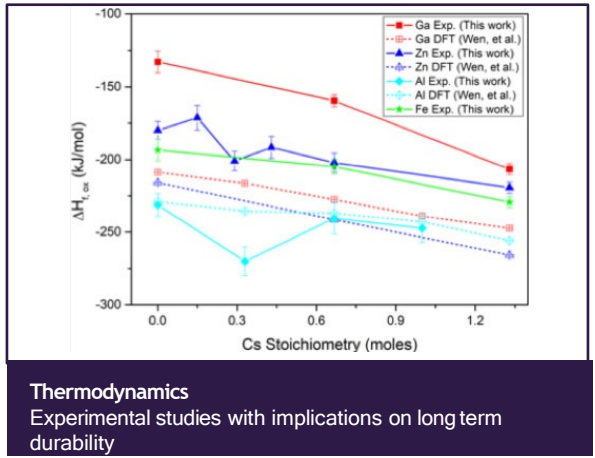
- Electrochemistry
- Ceramic Processing
- Nuclear Materials
- "Interface" between disciplines

Recent Projects -

- DOE-NEUP i) Crystalline Ceramic Waste Forms, ii) Tritium Management, using Proton Ceramic Membranes
- DOE-NETL: Proton Ceramics for Intermediate Temperature Fuel Cells

Publications/Patents -

- M.Zhao, Y. Xu, L. Shuller-Nickles, J.Amoroso, A.Frenkel, Y. Li, W. Gong, K.Lilova, A.Navrotsky, K.Brinkman Journal American Ceramic Society, 102 (7), 4314 (2019).
- R.Grote, M.Zhao, L.Shuller-Nickles, J.Amoroso, W.Gong, K.Lilova, A.Navrotsky, M.Tang, K.S.Brinkman, Journal of Materials Science, 54 (2), 1112, (2019).
- Y.Meng, L.Sun, W.Tan, C.Chen, J.Yi, H.J.M.Bouwmeester, Z Sun, J.Gao, K.Brinkman, ACS Applied Materials and Interfaces, 11, 11498, (2019).



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Areas of Expertise-

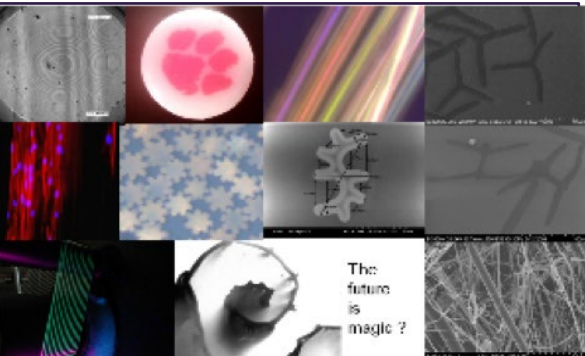
- Fiber production/characterization
- Polymer melt processing
- Polymer solution processing
- Multicomponent fiber materials

Recent Projects -

- ACREi) Moisture and Ammonia Mitigation,
- Natick Army ii) Super-omniphobic textile surfaces

Publications/Patents -

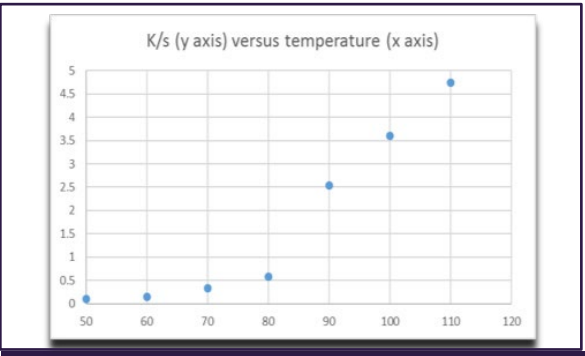
- Bicomponent Fiber Extraction Process for Textile Applications, Philip Mooney, John Shearer, Joey Mead, Carol Barry, Quoc Truong, Elizabeth A Welsh Richard Pang, Walter Zukas, Peter Stenhouse, Philip Brown, and Nicole Hoffman, Journal of Engineered Fibers and Fabrics Volume 3, Issue 1 - 2018
- Tugba Demir, Liying Wei, Naoki Nitta, Gleb Yushin, Philip J Brown, and Igor Luzinov, Applied Materials and Interfaces, American Chemical Society, pp 24318-24330, 9, 2017



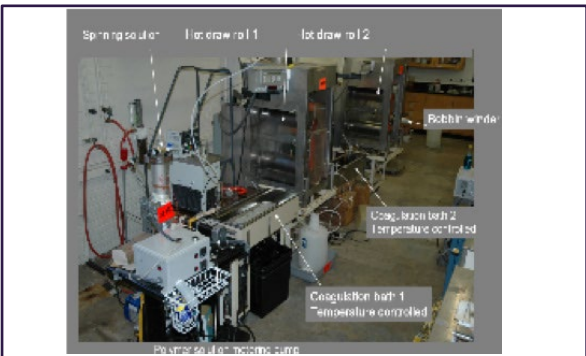
Fiber Fabrication
Production and characterization of complex fibers via melt extrusion, solution processing and multi-component spinning



Fiber melt processing
Quadra multi-component system



Color Science
Dyeing transition temperature



Fiber solution processing

STEPHEN FOULGER tahoe.clemson.edu

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Areas of Expertise-

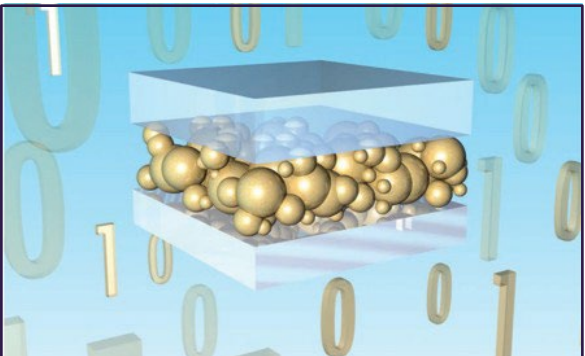
- Colloid Chemistry
- Polymer Chemistry
- Optoelectronic Devices
- Theranostic Colloids

Recent Projects -

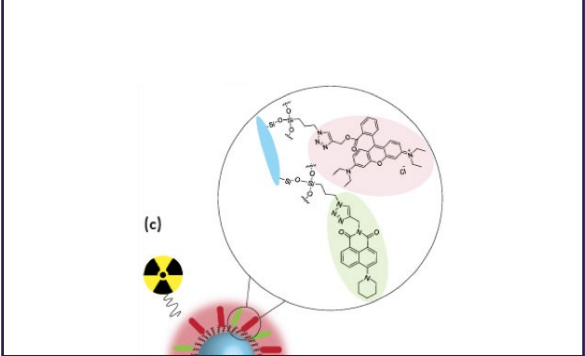
- NSF-DMR "Conductance Variability in Non-Conjugated Polymers: Memristors for Neuromorphic Applications"
- NSF-OIA "Track-II "RII Track-2 FEC: The Creation of Next-Generation Tools for Neuroscience - Noninvasive Radioluminescence Approaches to Optogenetics"

Publications/Patents -

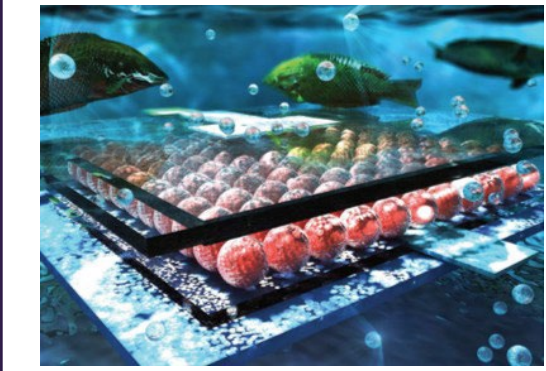
- Burdette, Bandera, Gray, and Foulger, "Dynamic Emission Tuning of X-ray Radioluminescent Crystalline Colloidal Arrays: Coupling the Optical Stop Band with Sequential Förster Resonance Energy Transfers", Advanced Optical Materials, 7, 1801142 (2019)
- Burdette, Bandera, Zhang, Trofimov, Dickey, Foulger, Kolis, Cannon, Bartley, Dobrunz, Bolding, McMahon, and Foulger, "Organic Fluorophore Coated Polycrystalline Ceramic LSO:Ce Scintillators for X-ray Bioimaging", Langmuir, 35, 171-182 (2019)



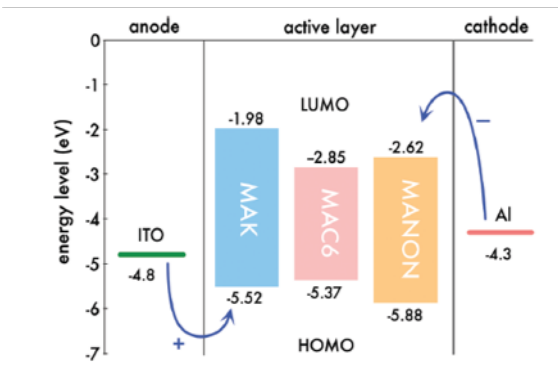
Organic Memristors
Colloid memristors for synaptic mimicry



Theranostic Colloids
X-ray nanoparticles for optogenetics



BioBased Printed Batteries, OLEDs, and Conductive Polymers
Multifunctional devices through polymer structure-property synthesis



DONG HOU <https://bio.link/hou>

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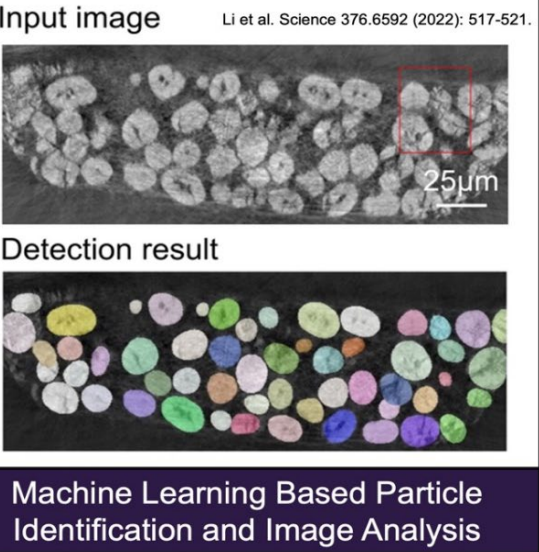
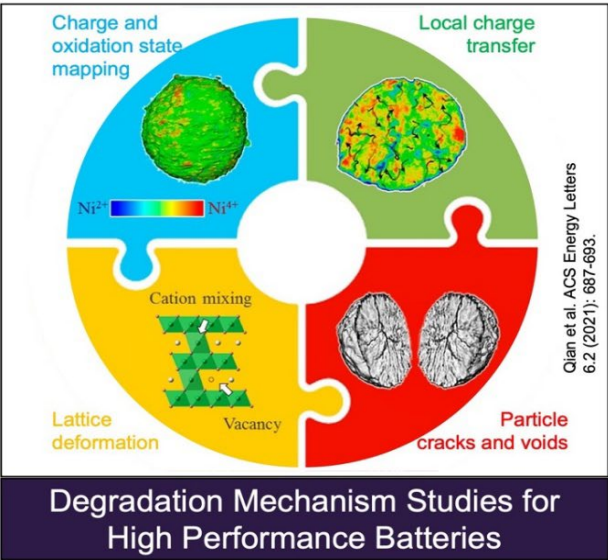
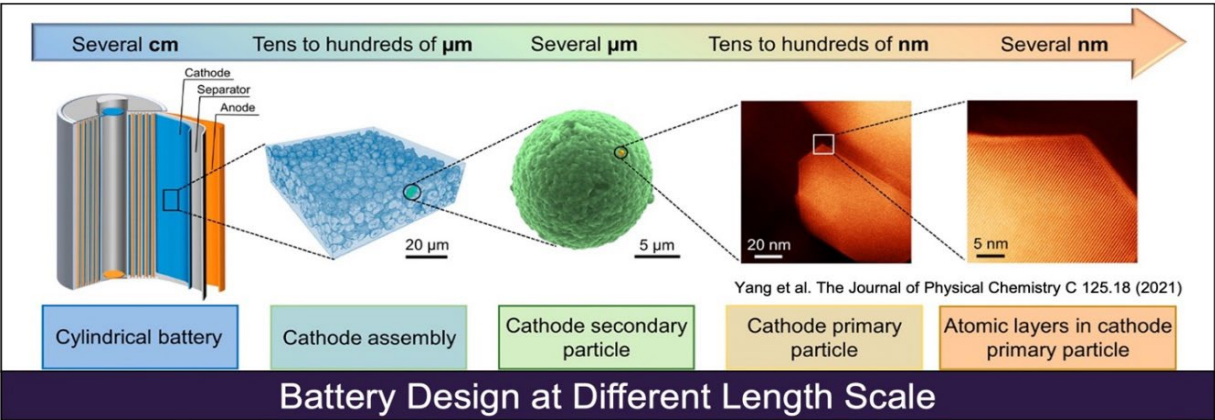
- Clean Energy, Sustainability, Electrochemistry, Batteries
- Inorganic Chemistry, Crystallography
- Advanced Characterization, in-situ/Operando, Synchrotron, Neutron
- Data Science, Artificial Intelligence, Machine Learning

Recent Projects -

- Fabrication and Microstructure Engineering of Battery Electrodes for Electronic Vehicles
- Data-driven, AI-guided Design and Development of Micro-batteries
- In-line Metrology for Battery Manufacturing

Publications/Patents -

- Revealing the Chemical and Structural Complexity of Electrochemical Ion Exchange in Layered Oxide Materials. *Journal of the American Chemical Society (JACS)* 2024, :jacs.4c08089.
- Cross-length-scale investigation reveals the spatial thermo-chemical dynamics hidden in Ni-rich layered Li-ion cathodes. *Matter* 2023, 7(2):640-654.
- Dynamics of particle network in composite battery cathodes. *Science* 2022, 376(6592)
- Effect of the grain arrangements on the thermal stability of polycrystalline nickel-rich lithium-based battery cathodes. *Nature Communications* 2022, 13(1)
- Surface coating by mechanofusion modulates bulk charging pathways and battery performance of Ni-rich layered cathodes. *Proceedings of the National Academy of Sciences (PNAS)* 2022, 119(49)



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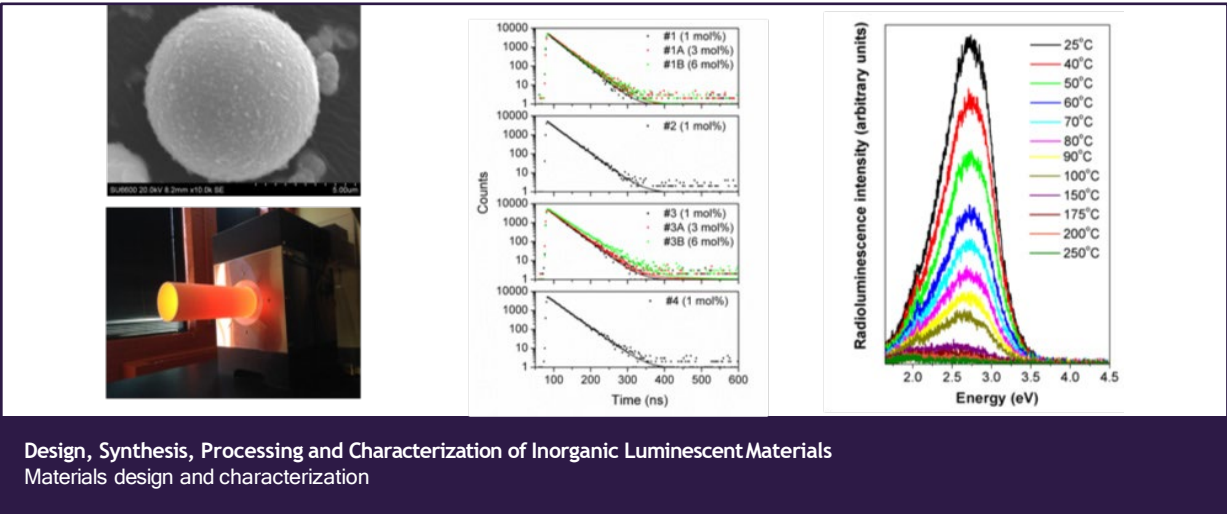
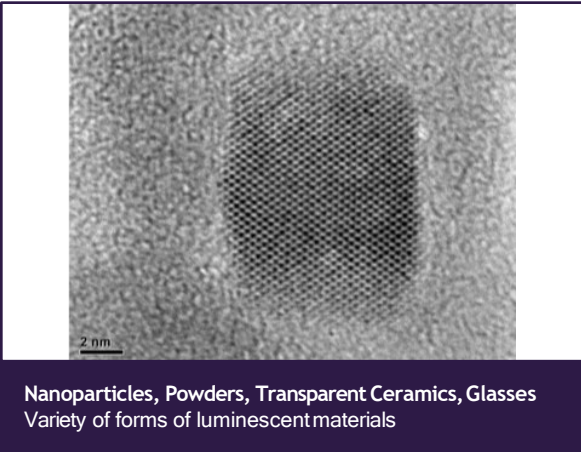
- Luminescence Dosimeters
- Scintillators
- Luminescent Materials
- Optical Materials
- Synthesis, Processing and Characterization of Ceramics
- Radiation Damage

Recent Projects -

- NSF: CAREER- Towards Engineering Electronic Defects in Inorganic Luminescent Materials
- DTRA: Reactive Membranes for Rapid Isotopic Analyses of Waterborne Special Nuclear Material

Publications/Patents -

- L.Pan, S. SWSMcKeever, and LGJacobsohn, Journal of Alloys and Compounds 880, 160503 (2021)
- A.A.Trofimov, T.A.DeVol, and LGJacobsohn, Journal of Luminescence 238, 118229 (2021)
- MW.Kiely, L. Pan, M. A.Dettmann, V.Herrig, U.Akgun, and LGJacobsohn, Journal of Materials Science: Materials in Electronics 30, 16774-16780 (2019)



MARK JOHNSON [researchgate.net/scientific-contributions/2056721905 Mark Johnson](https://www.researchgate.net/scientific-contributions/2056721905/Mark-Johnson)

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Research Areas and Interests-

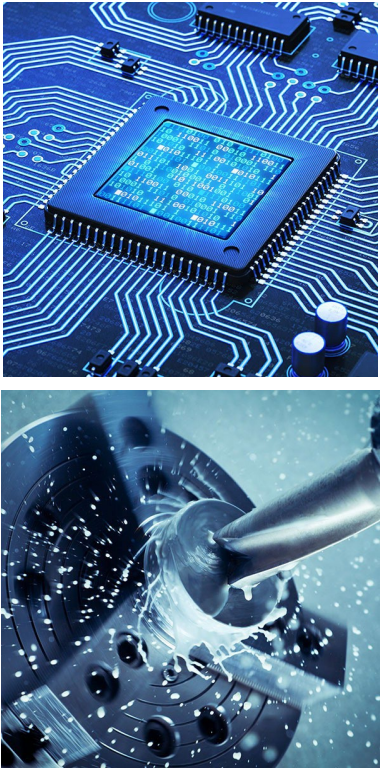
- Compound Semiconductor Materials & Devices:
 - Wide-Bandgap Materials and Structures
 - MBE and MOCVD Growth and Functional Processing
- Clean Energy Technologies:
 - Energy Storage (Stationary), Rare Earth Materials and System Enabling Material
- Advanced Manufacturing Technologies
 - Information Technology and SMART Manufacturing
 - AI/ML and HPC for Materials Manufacturing
- Technology Commercialization
 - Early-Stage Venture formation
- Science and Energy Related Public Policy

All of Clemson Effort: Research, Education and OutreachSouth Carolina State Appropriation (\$4M in FY20) -

- Education: AM Senior Experience at ICAR (Start with ME, plus CSC)
- Research: Matching Funds for Competitive Solicitations
- Outreach: Enhance Innovation Eco-System
- Partnerships: Workshops and Thought Leadership

Focus Areas

- Clemson Already Doing “Advanced Manufacturing” in >40 Groups, Labs, Centers and Institutes♦ Catalyze for Whole > Parts♦
- Advanced Materials and their Manufacturing is High Opportunity



MARIAN KENNEDY [cecas.clemson.edu/kennedylab/Kennedy_Research_Group/Overview](https://www.clemson.edu/kennedylab/Kennedy_Research_Group/Overview)

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Areas of Expertise-

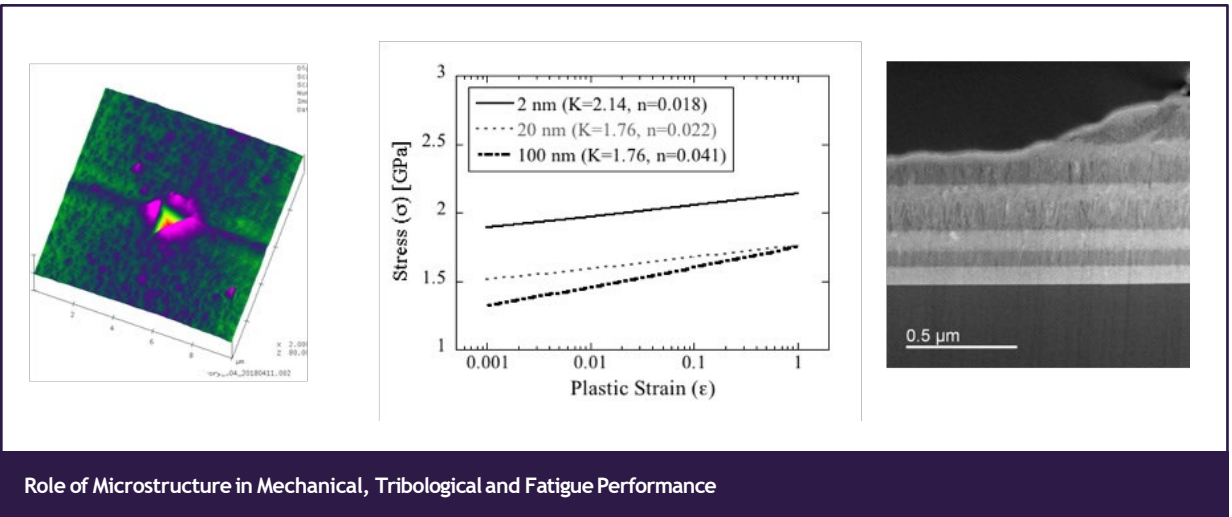
- Thin film mechanical behavior and tribology
- Engineering education: self-efficacy, undergraduate research

Recent Projects -

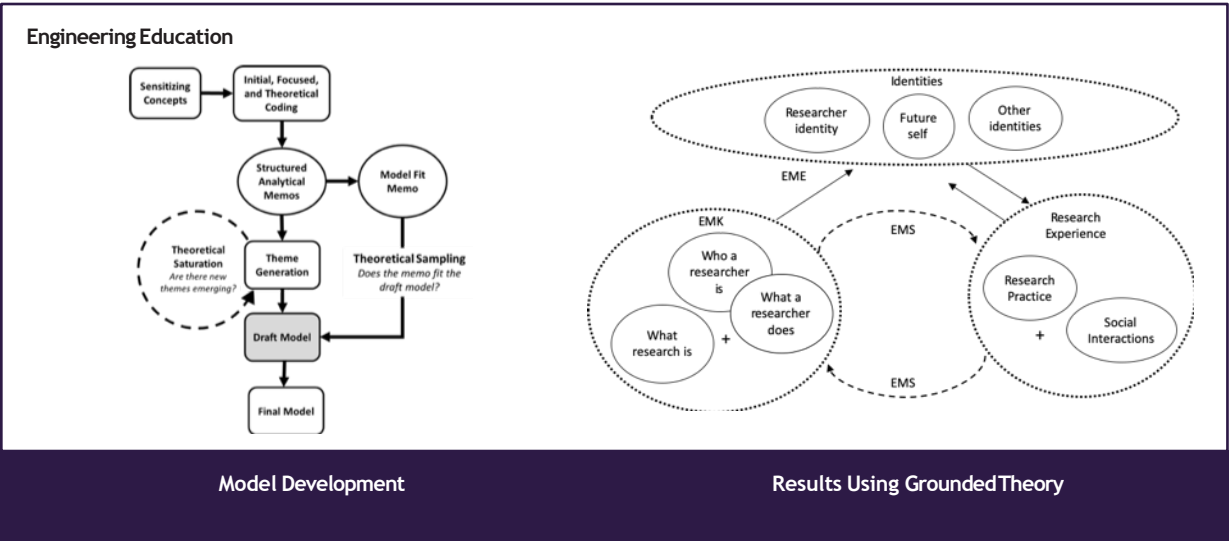
- NSF - Student Perspectives on Researcher Identity and Transformed Epistemologies
- DoD - Preventing Infection by Surface Modification of Orthopaedic Fracture Fixation Implants for Improved Limb Salvage Outcomes
- SRNL- Silicon Carbide Permeation

Publications/Patents -

- In-situ observations of the fracture and adhesion of Cu/Nb multilayers on polyimide substrates, M.J.Cordill et al, Materials Science and Engineering: A (2018)
- Electrochemical Behavior of Copper and Niobium Monolithic and Layered Thin Films, C.Sewell et al, CORROSION 2019 (2019)
- Dynamics of Researcher Identity and Epistemology: The Development of a Grounded-theory Model, ASEE(2019)



Role of Microstructure in Mechanical, Tribological and Fatigue Performance



Model Development

Results Using Grounded Theory

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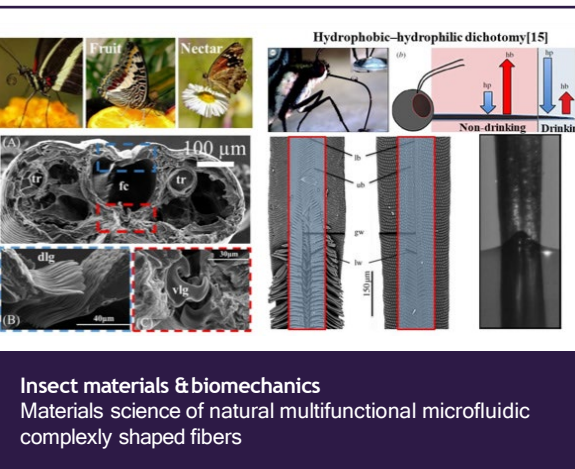
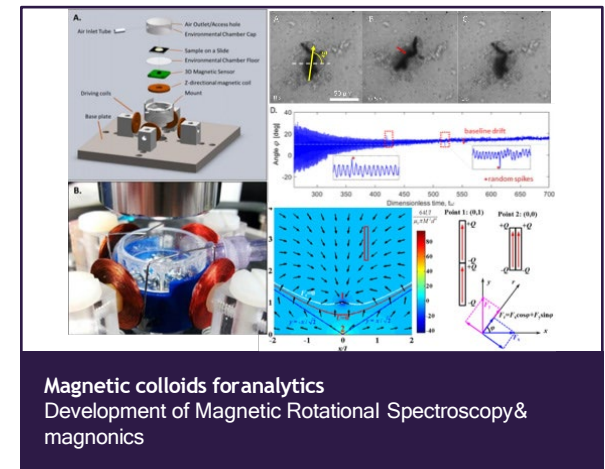
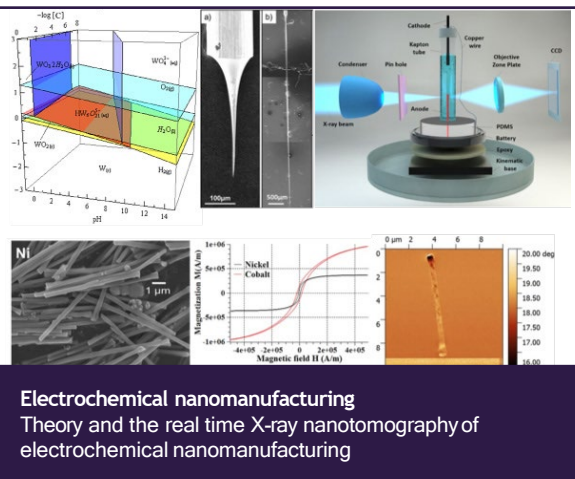
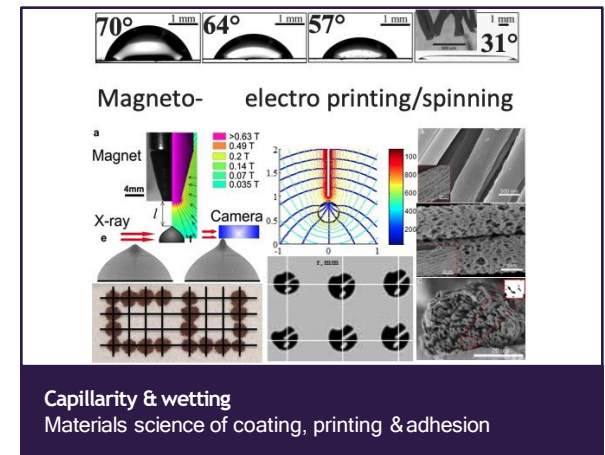
- Thermodynamics & continuum mechanics of materials
- Capillarity & wetting
- Magnetic colloids for analytics
- Nanomanufacturing in electric & magnetic fields
- Biomechanics of insects

Recent Projects -

- National Science Foundation
- Air Force Research Laboratory
- NASA EPSCoR

Publications/Patents -

- Aprelev, P., Bruce, T.F., Beard, C.E., Adler, P.H., Kornev, K.G., Scientific Reports, 9, 3451 (2019)
- Zhang, C., Beard, C.E., Adler, P.H., Kornev, K.G., R Soc. open



OLGA KUKSENOK kuksenok.github.io/

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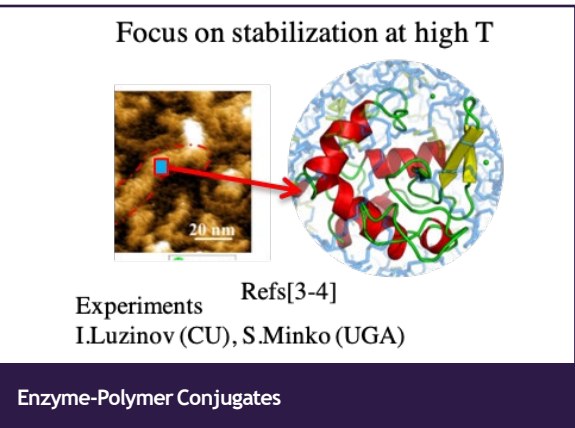
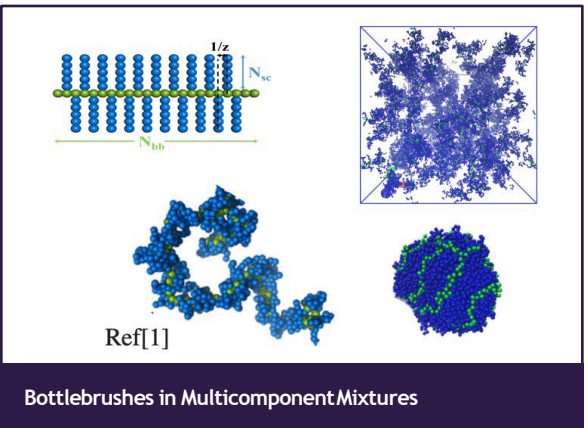
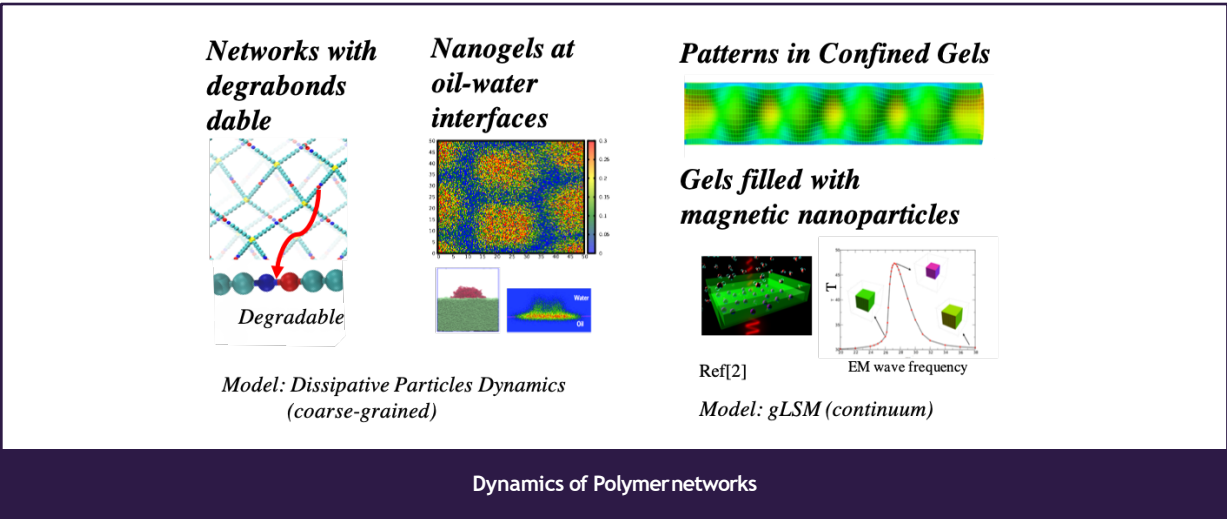
- Dynamics of responsive polymer gels
- Modeling of multicomponent polymer blends
- Pattern formation out-of-equilibrium

Recent Projects -

- ACSPRF "Multi-Scale Modeling of Dynamics of Polymer Gels in Oil-Water Mixtures"
- NSF MADE in SCEPSCoR, NSF Biophysics REU

Publications/Patents -

- [1] Tu, S., Choudhury, C.K., Luzinov, I., Kuksenok, O. Recent advances towards applications of molecular bottlebrushes and their Conjugates". Current Opinion in Solid State and Materials Science 23, 1, pp 50-61 (2019)
- [2] Savchak, O., Morrison, T., Kornev, K.G. and Kuksenok, O., Controlling deformations of gel-based composites by electromagnetic signals within the GHz frequency range. Soft matter, 14(43), pp. 8698-8708 (2018)
- [3] Choudhury, C.K.; Tu, S.; Luzinov, L.; Minko, S.; Kuksenok, O. "Designing Highly Thermostable Lysozyme-Copolymer Conjugates: Focus on Effect of Polymer Concentration" Biomacromolecules 19 (4), 1175-1188 (2018)
- [4] Yadavalli NS, Borodinov N, Choudhury CK, Quiñones-Ruiz T, Laradji, Tu S., Lednev IK, Kuksenok O, Luzinov I, Minko S "Thermal Stabilization of Enzymes with Molecular Brushes", ACS Catalysis, 7 (12) 8675-8684 (2017)



IGOR LUZINOV clemson.edu/cecas/departments/mse/people/faculty

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Areas of Expertise-

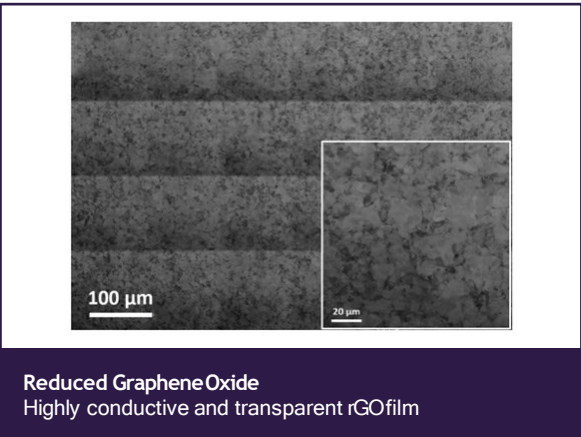
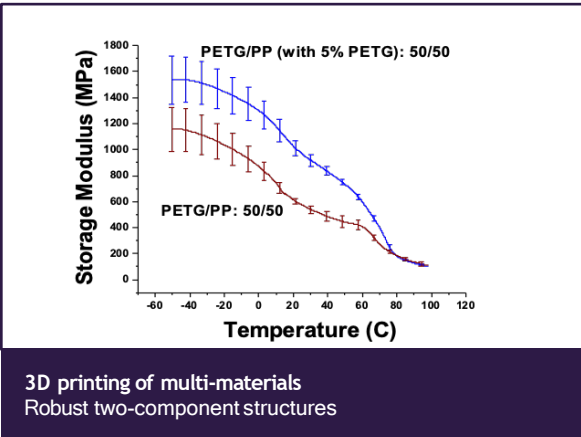
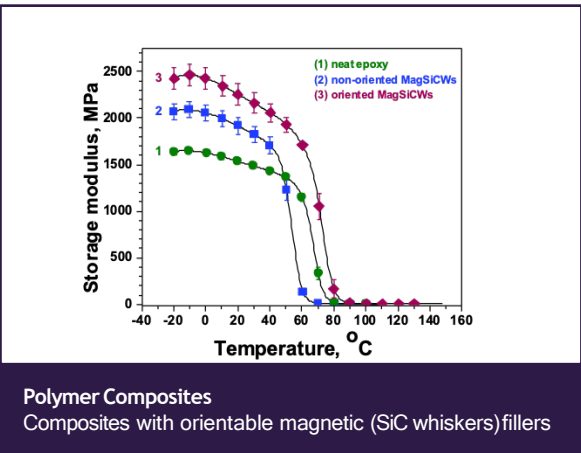
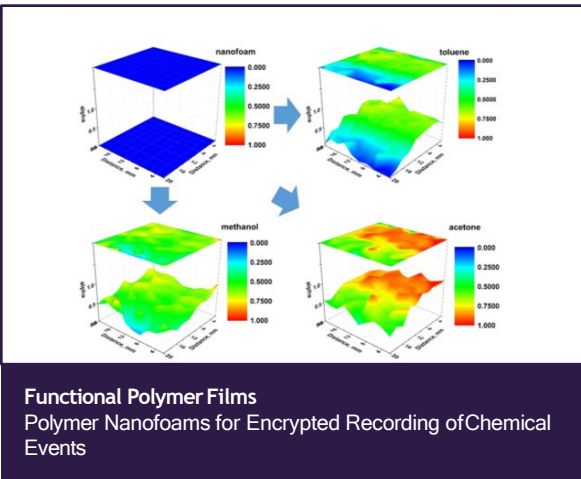
- Polymers and composites
- Thin films and coatings
- Fibrous materials
- Interfaces and adhesion
- 3D printing

Recent Projects -

- NSF CMMI: Highly Conductive Reduced Graphene Oxide Films for High Performance Electronic Devices
- DECAF Inc: Molecularly Imprinted Fibers for Decaffeination

Publications/Patents -

- Van Tooren, M;Luzinov, I US Patent 10,240,012, March 26, 2019
- Saychak, M Luzinov, I et al, ACS Appl. Materials & Interfaces 2018, 10 (4), 3975
- Wei, L.Y.;Luzinov, I Et al Langmuir 2018, 34, 12934
- Townsend, J.;Luzinov, I et al ACS Appl. Materials & Interfaces 2017, 9 (27), 22927
- Borodinov, N.;Luzinov, I et al ACS Nano 2016, 10 (12), 10716



PETRO MAKSYMOVYCH <https://github.com/amplopy>

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Areas of Expertise-

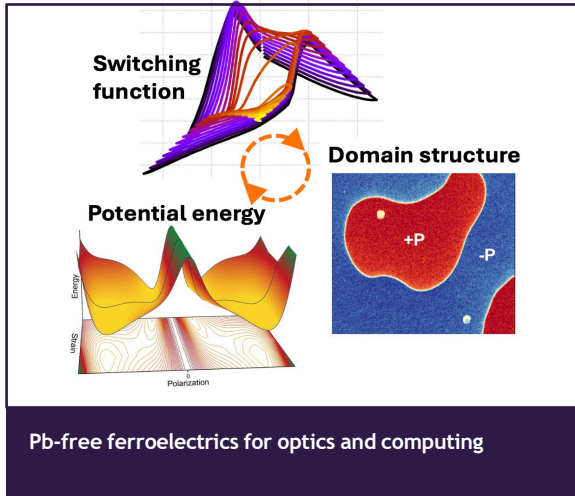
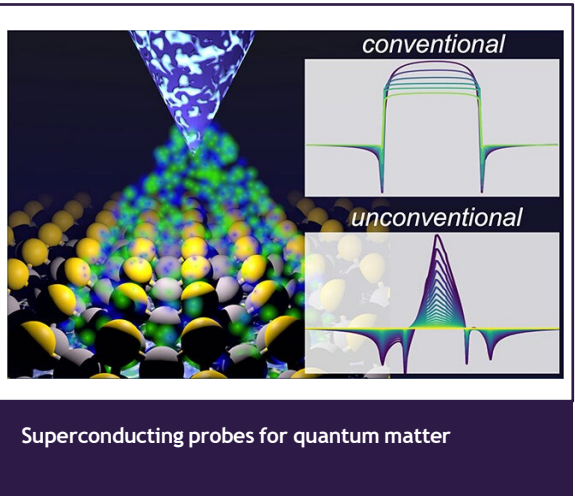
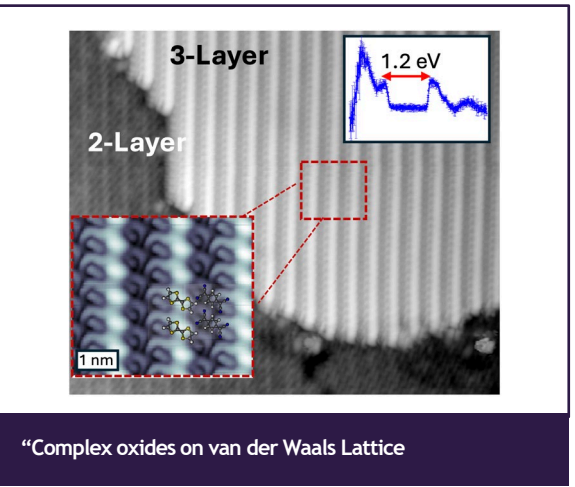
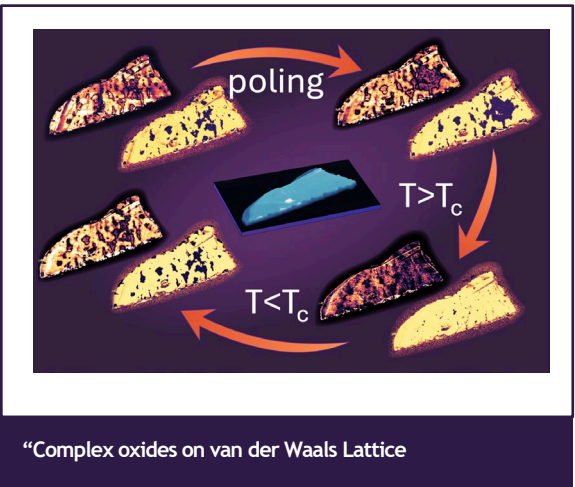
- Quantum materials
- Phase transitions
- Electronic Devices
- Scanning force/probe microscopy

Recent Projects -

- DOE (BES-ASCR): "Deep Codesign of an Energy-Optimized, High Performance Neuromorphic Accelerator"
- DOE (BES): BES "Nanoscale quantum and classical sensing for superconducting and topological quantum information"

Publications/Patents -

- Atomic-Scale Andreev Probe of Unconventional Superconductivity, Nano Lett., 23 (2023), 8310
- Dynamic stabilization of metastable states in triple-well Sn2P2S6, Adv. Mat, 35 (2023) 2211194.
- Electronic Thermometry in Tunable Tunnel Junction, P. Maksymovych, US Patent: 9,285,279



ENRIQUE MARTINEZ SAEZ

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Areas of Expertise-

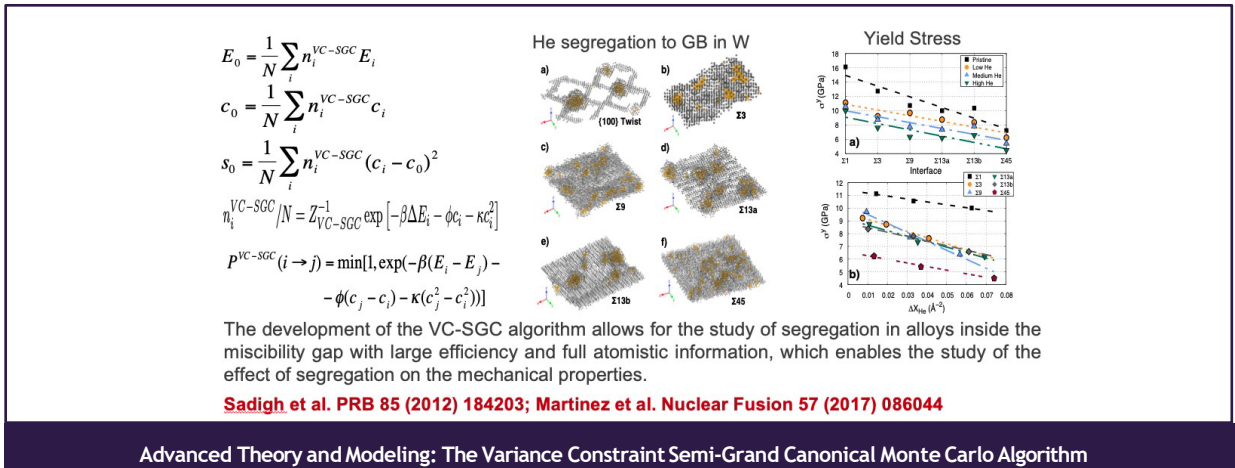
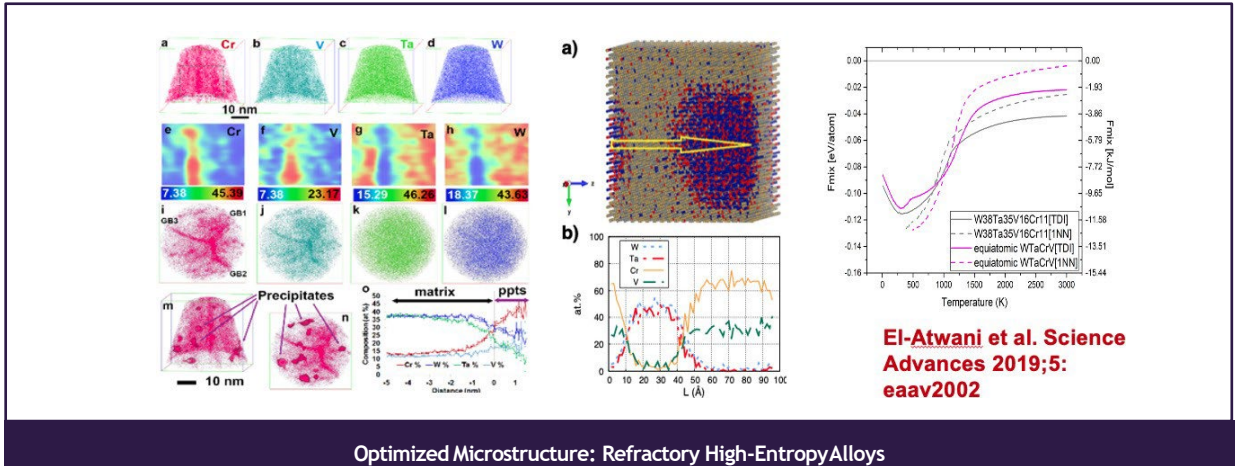
- Microstructure evolution
- Thermodynamics and kinetics of metallic alloys
- Advanced manufacturing
- Mechanical response

Recent Projects -

- DOE (BES-ASCR): Plasma Surface Interactions: Predicting the Performance and Impact of Dynamics Plasma-Facing-Components Surfaces
- DOE-EXAALT: Molecular Dynamics at Exascale for Materials Science (Exascale Computing Project)
- LANL (LDRD): Shocked Chemistry Dynamics in High Explosives

Publications/Patents -

- Outstanding Radiation Resistance of Tungsten-based High Entropy Alloys, OEI-Atwani, et al, Science Advances 2019; 5: eaav2002
- Role of Sink Density in Nonequilibrium Chemical Redistribution in Alloys, EMartinez, et al, Physical Review Letters 120 (2018) 106101
- Relative relevance of mobility and driving force on edge dislocation climb by the vacancy mechanism, EMartinez, et al, Computational Materials Science 193 (2021) 110378



THOMPSON MEFFORD meffordresearch.com

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Areas of Expertise-

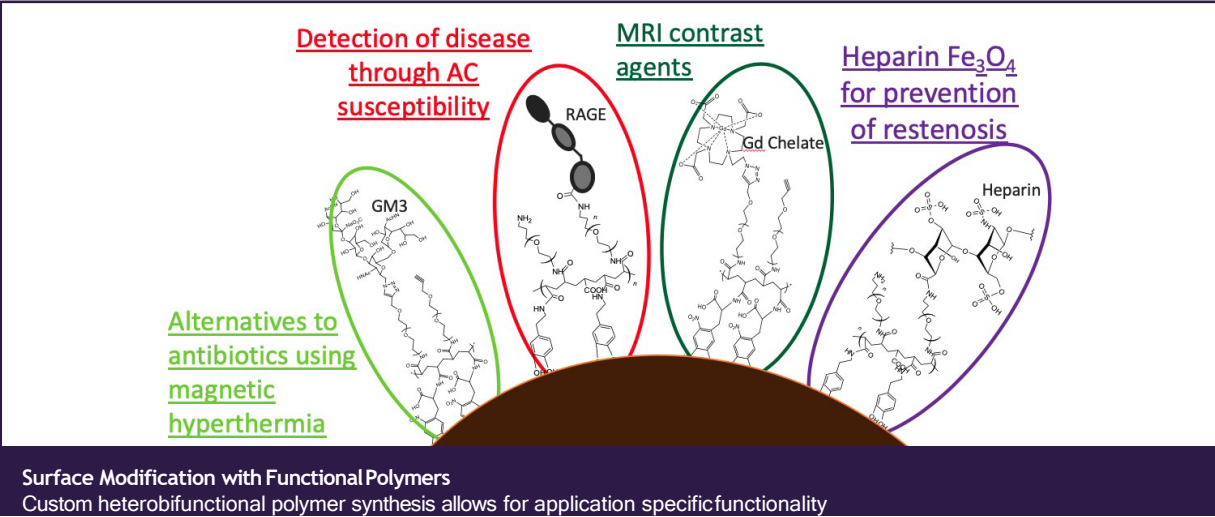
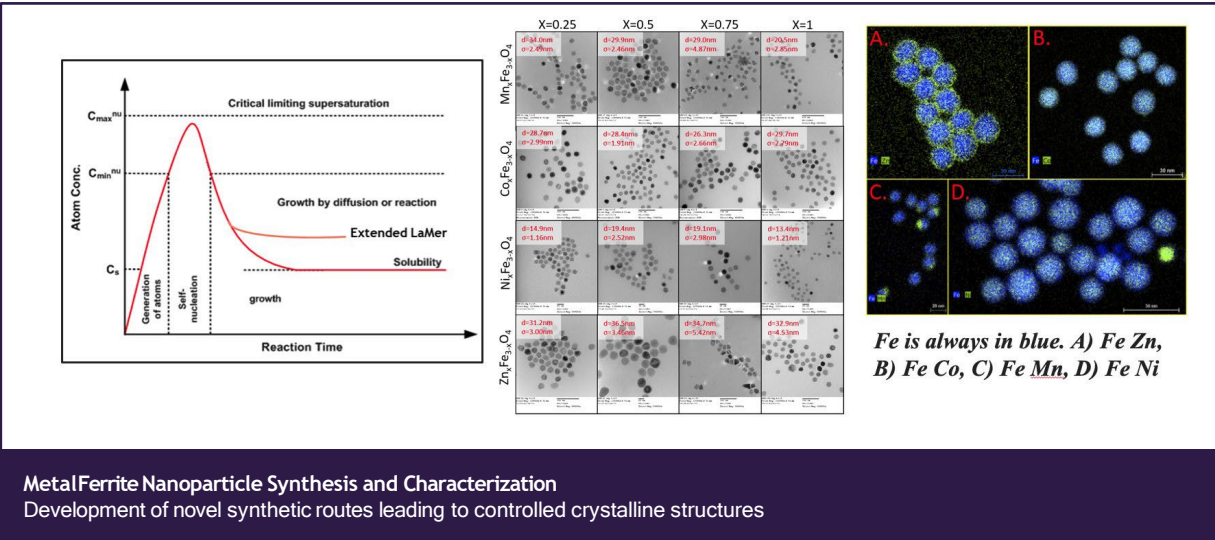
- Nanoparticle Synthesis
- Polymer Synthesis
- Magnetic Materials
- Biomaterials
- Surface Chemistry

Recent Projects -

- MRI contrast agents to measure mild traumatic brain injuries
- Selective binding/inactivation of target pathogen Neisseria gonorrhoeae

Publications/Patents -

- Fellows, Benjamin D, et al "In vitro studies of heparin-coated magnetic nanoparticles for use in the treatment of neointimal hyperplasia." Nanomedicine: Nanotechnology, Biology and Medicine 14.4 (2018): 1191-1200
- Davis, Kathleen, et al "The effect of post-synthesis aging on the ligand exchange activity of iron oxide nanoparticles." Journal of colloid and interface science 511 (2018): 374-382
- Andrew, Jennifer Set al "Synthesis and Surface Functionalization of Ferrite Nanoparticles." Nanomagnetic Actuation in Biomedicine. CRC Press, 2018. 9-40



FEI PENG cecas.clemson.edu/peng

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Areas of Expertise-

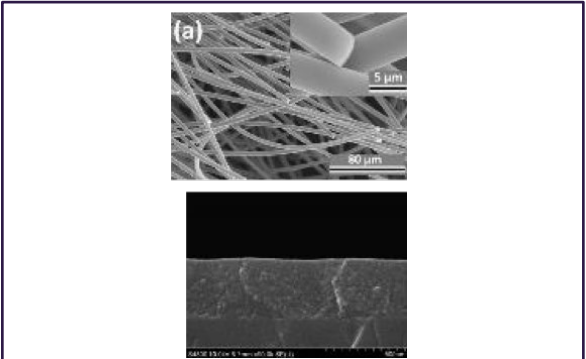
- Sol-gel processing
- Laser sintering of ceramics
- Integrated additive/subtractive manufacturing
- Nuclear Materials

Recent Projects -

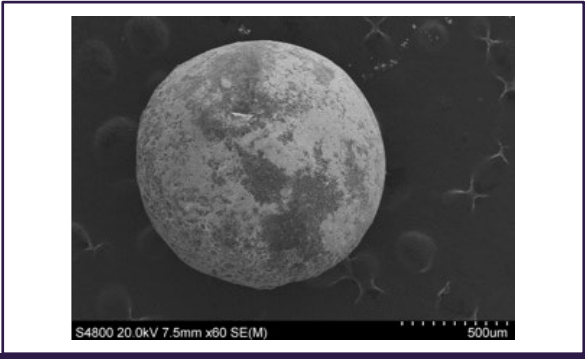
- NIH-COBRE: in vivo characterization of contact stress distribution in hip replacement
- BWXT/NASA: Fabrication of uranium nitride microspheres
- DoE-NETL: Integrated TBC/EBC for SiC Fiber Reinforced SiC Matrix Composites for Next Generation GasTurbines
- DoE-EERE: Additive manufacturing of proton electrolyzer

Publications/Patents -

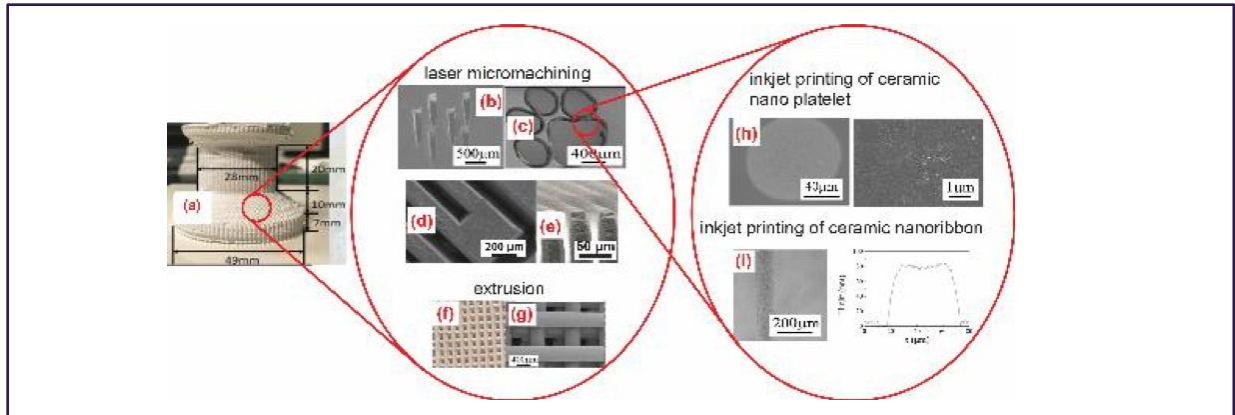
- Lei, Jincheng, et al. "The effect of laser sintering on the microstructure, relative density, and cracking of sol-gel derived silica thin films." Journal of the American Ceramic Society.
- Hong, Yuzhe, et al. "Fabricating ceramics with embedded microchannels using an integrated additive manufacturing and laser machining method." Journal of the American Ceramic Society 102. 3 (2019): 1071-1082



Low dimensional ceramics
Ceramic fibers and coatings



Uranium nitride microspheres



Integrated additive/subtractive manufacturing of ceramics

CHENG SUN

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Areas of Expertise-

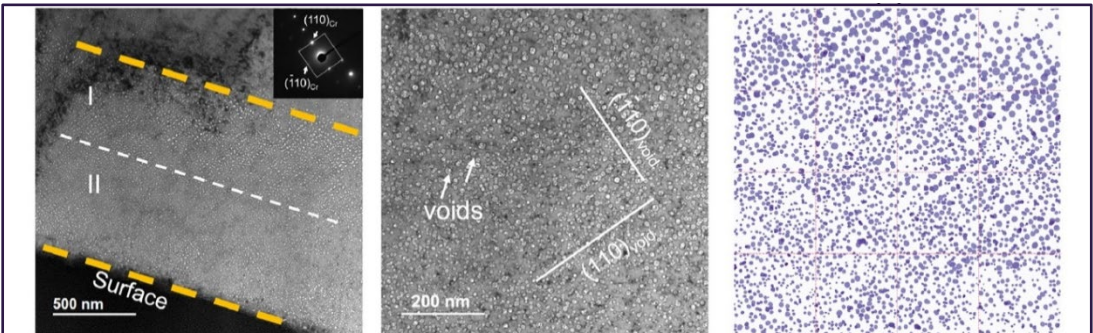
- Materials under extreme conditions
- Advanced Manufacturing
- Machine learning in materials characterization

Recent Projects -

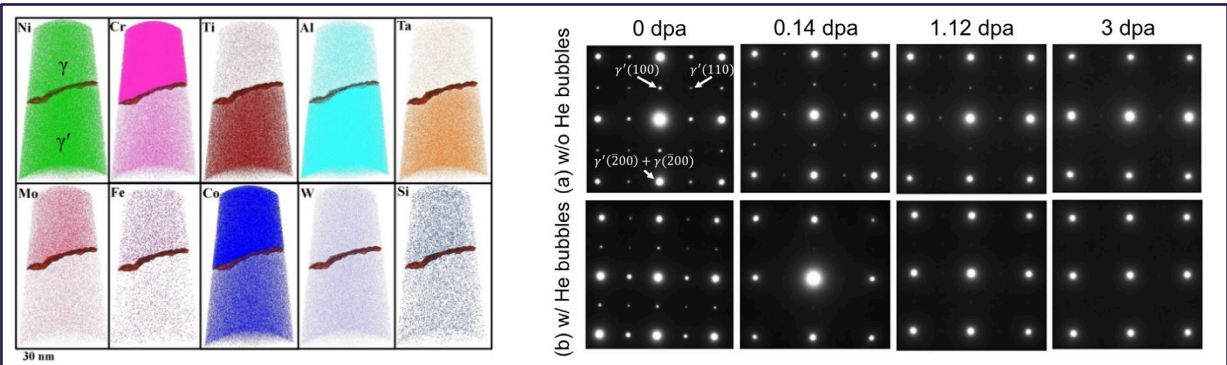
- Self-organization of defects in materials
- Machine learning in alloy design
- Development of advanced fusion materials

Publications/Patents -

- Unveiling the interaction of nanopatterned void superlattices with irradiation cascades, C. Sun et al., Acta Materialia, 239 (2022): 118282
- Materials Genomics Search for Possible Helium-absorbing Nanophases in Fusion Structural Materials, H. Xu et al., Advanced Sciences, 9 (2022), 2203555
- Additive Manufacturing for Energy: A Review, C. Sun, et al., Applied Energy, 282 (2021): 116041
- Formation window of gas bubble superlattice in molybdenum under ion implantation, C. Sun et al., Physical Review Materials, 3 (2019): 103607



Computer Vision in Defects Analysis (Defect Self-organization under irradiation
[Cheng Sun, et al., Acta Mater., 2022]



Materials Under Extreme Conditions (Phase transformation under irradiation)
[Cheng Sun, et al., Mater. Character., 2021]

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Areas of Expertise-

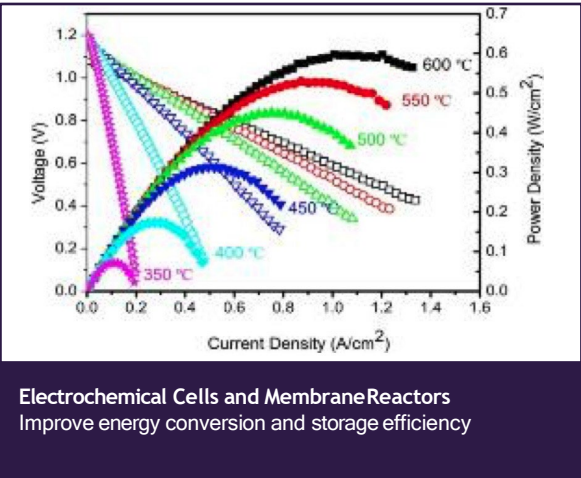
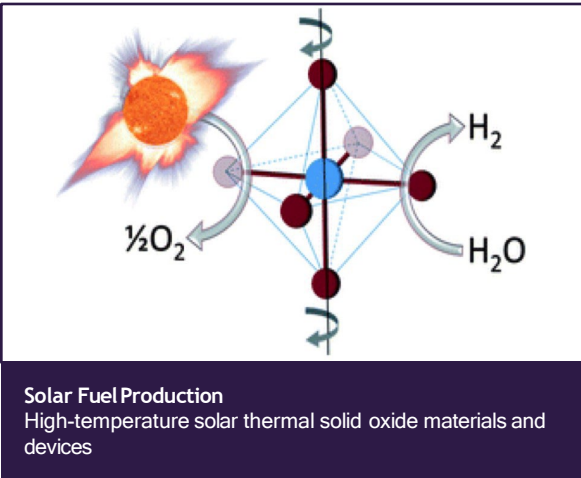
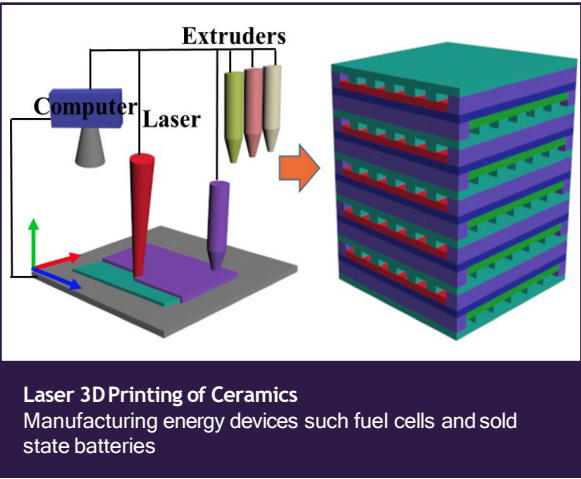
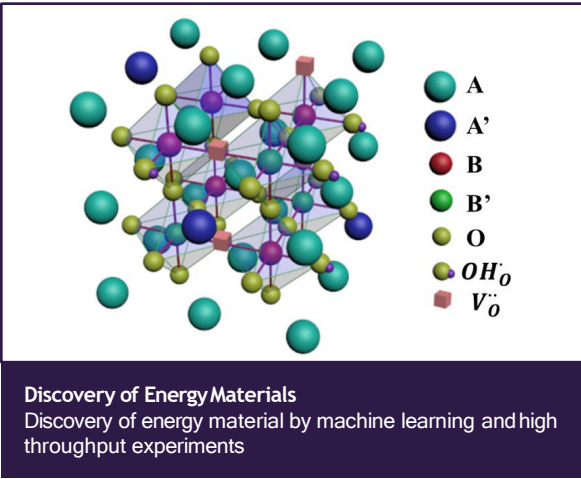
- Energy Materials an Devices
- Electrochemical Cells and Membrane Reactors
- Solar Fuel Production
- 3D Printing and Laser Processing of Ceramics

Recent Projects -

- DOE-EERE: Laser 3D printing of protonic ceramic electrolyzer stack
- ACS-PRF: Co-production of ammonia and ethene from naturalgas
- DOE-ORNL: Go! Program

Publications/Patents -

- C.Duan, J.Tong, M.Shang, S.Nikodemski, M.Sanders, S.Ricote, A.Almansoori, R.O'Hayre, Science, 2015, 249, 1321
- DRBarcellos, MD.Sanders, J.Tong, A.H.McDaniel, RP O'Hayre, Energy & Environmental Science, 2018, 11, 3256
- S.Mu, Z.Zhao, J.Lei, Y.Hong, T.Hong, D.Jiang, Y.Song, V.Jackson, K.S.Brinkman, F.Peng, H.Xiao, J.Tong, Solid State Ionics, 2018, 320, 369
- D.Jiang, Z.Zhao, S.Mu, V.Phaneuf, J.Tong, International Journal of Hydrogen Energy, 2019, 44, 18360



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Areas of Expertise-

- Polymer Science
- Materials Chemistry; Polymerization
- Stimuli-Responsive Polymers
- Self-Healing Polymers
- Polymer Spectroscopy/Chemical Imaging
- Poly(Ionic Liquids) (PILs)
- Dipolar and Ionic Interactions in Polymers

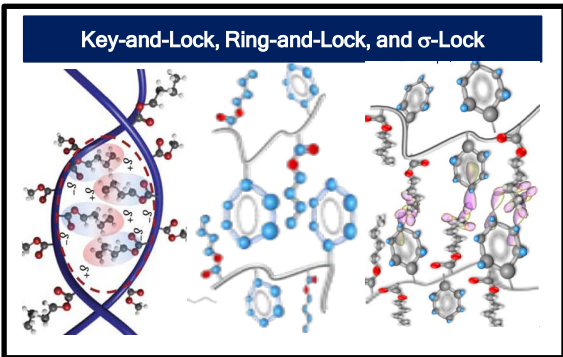
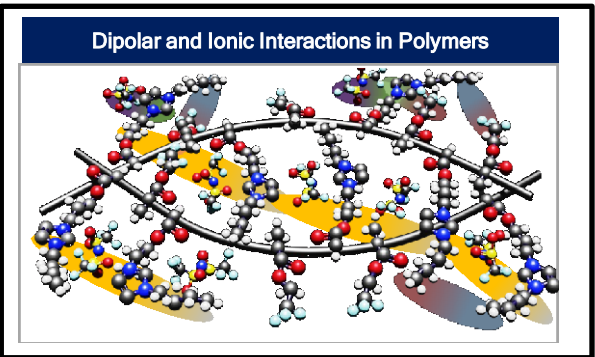
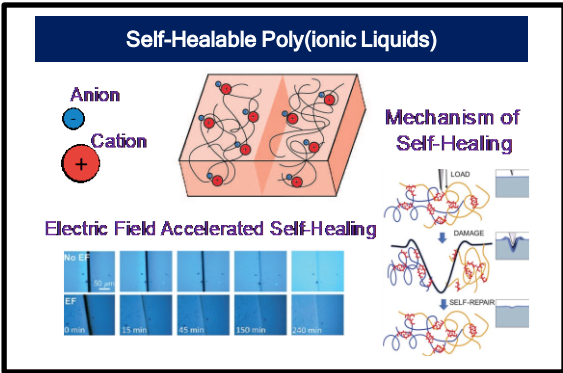
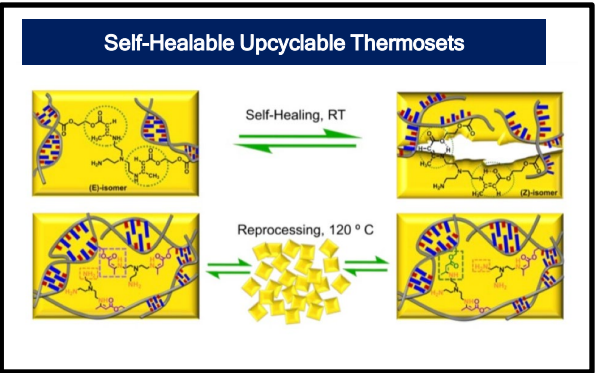
Recent Projects -

- NSF DMR Self-Healing Commodity Copolymers
- DOE Dipolar and Ionic Interactions in Polymers
- NSF International Experience for Students (IRES)
- DOE Self-Healable Materials in Hydrogen-Fuel Technologies

Publications/Patents -

- S. Gaikwad, M.W. Urban, *Angew. Chemie Inter. Ed.* 2024, 63, e202405504.
- S. Gaikwad, M.W. Urban, *J. Amer. Chem. Soc.*, 2023, 145, 17, 9693-9699.
- J. Liu, M.W. Urban, *Langmuir*, 2024, 40, 14, 7268-7285.
- S. Wang, M.W. Urban, *CHEM*, 2023, 9, 1362-1377.
- Q. Liu, M.W. Urban, *Polymer Reviews*, 2023, 63, 2, 289-323.
- D Davydovich, MW Urban, *Nature Comm.*, 2020, 11 (1), 5743.
- S. Wang, M.W. Urban, *Nature Reviews Materials*, 2020, 5, 562-583.
- US Patent 11,312,807 (2022); US Patent 10,465,033 (2019); Self-Healable Poly(ionic Liquids)
- US Patent 10,077,378 (2018).

Angew. Chemie Inter. Ed. 2024, 63, e202405504; Macromolecules, 2024, 57, 5831–5837; J. Amer. Chem. Soc., 2023, 145, 17, 9693-9699; Small, 2022, 18, 2201952; Macromolecules, 2022, 55(11), 4703-4709; ACS Applied Polym. Materials, 2022, 4, 12, 9360-9367; Adv. Science, 2021, 8, 2101399; Science, 2018, 362, 220; Science, 2009, 323, 1458; CHEM, 2018, 4(8), 1928; Adv. Mater., 2017, 29, 1603334; Nature Chem., 2012, 4, 80-82.



KIMBERLY WEIRICH

Department of Materials Science and Engineering, ClemsonUniversity

Areas of Expertise-

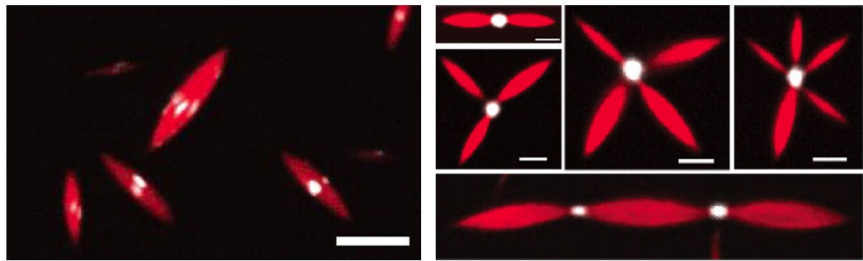
- Biological and bioinspired materials
- Soft and active materials
- Liquid crystals
- Biopolymers

Recent Projects -

- Self-organization and shape change in active droplets
- Designing motile synthetic cells–structural biomaterials
- Composite biopolymer liquid crystals

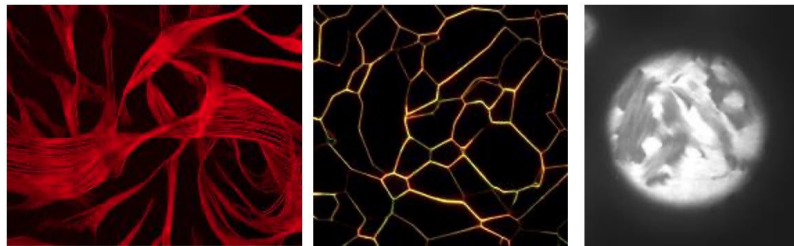
Publications/Patents -

- Self organizing motors divide active liquid droplets, KLWeirich, et al, Proceedings of the National Academy of Sciences; 116 (23):11125-11130 (2019)
- Tuning shape and internal structure of protein droplets via biopolymer filaments, DScheff, et al, Soft Matter 16(8): 2135-2140 (2020)
- Actin bundle Architecture and mechanics regulates myosin II activity, KLWeirich, et al, Biophysical Journal 120 (10): 1957-1970 (2021)
- Liquid behavior of cross-linked actin bundles, KLWeirich, et al, Proceedings of the National Academy of Sciences; 114 (9): 2131-2136 (2017)



In these biopolymer liquid crystalline materials, active and passive colloidal particles self-organize into bio-inspired assemblies, where particles align at the midplane and divide the droplet into two or more separate, spindle shaped droplets.
Weirich et al., PNAS 2019, Weirich et al., PNAS 2017, Scheff et al. Soft Matter 2020

Active shape-changing, self-organizing materials



Cytoskeletal filament materials form the soft polymer material that regulates shape and is the basis for the unusual mechanics found in biological cells. Using purified proteins, we make biomimetic cytoskeletal assemblies and investigate the influence of microstructure on these exotic materials.
Weirich et al. Biophys. J. 2021, Scholz et al. Soft Matter 2020, Stam et al. PNAS 2017

Mechanics and microstructure in active biopolymer materials

Tianyu Zhu cecas.clemson.edu/tonggroup

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Areas of Expertise-

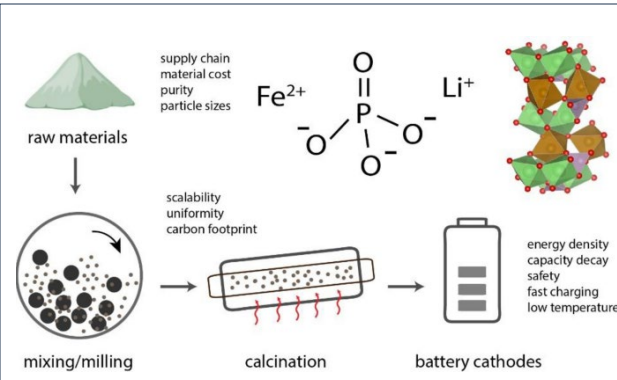
- Polymer Synthesis
- Ceramic Engineering
- Solid-State Electrodes
- Battery Manufacturing

Recent Projects -

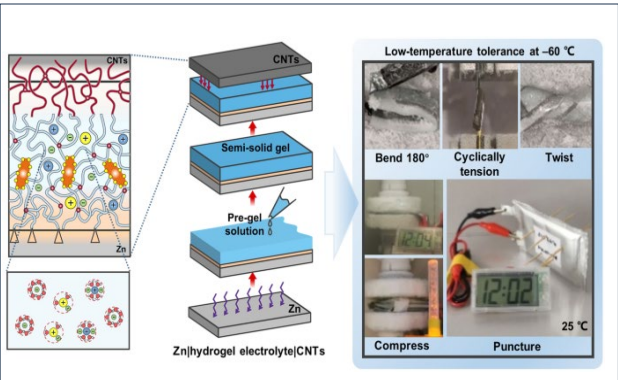
- Low-cost manufacturing of cathode materials
- Topological polymers for ion transport

Publications/Patents -

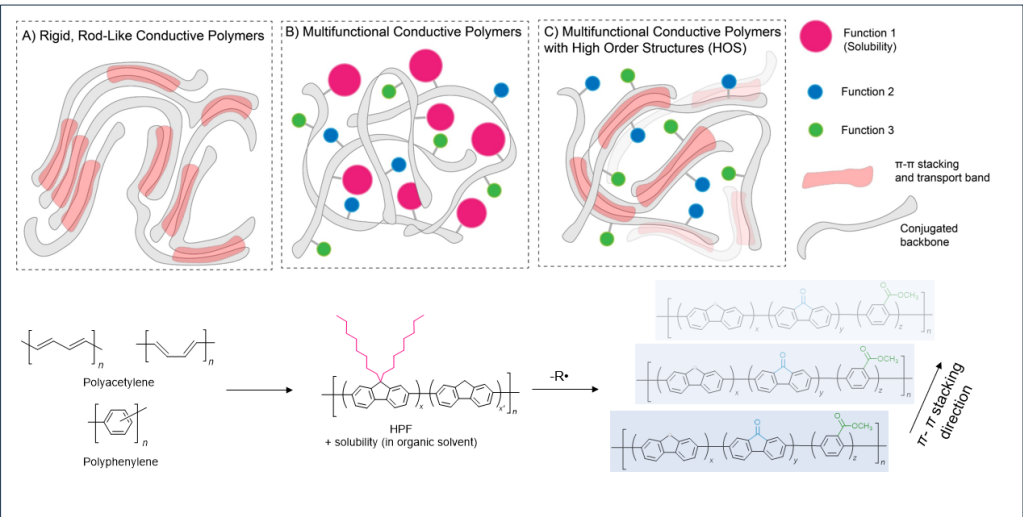
- Lu, Y., Zhu, T. et al. "Status and prospects of lithium iron phosphate manufacturing in the lithium battery industry" MRS Commun., 14, 888 (2024).
- Nan, J., Zhu, T. et al. "Coupling of Adhesion and Anti-Freezing Properties in Hydrogel Electrolytes for Low-Temperature Aqueous-Based Hybrid Capacitors" Nano-Micro Lett., 16, 22 (2024).
- Zhu, T., Liu, G. et al. "Formation of Hierarchically Ordered Structures in Conductive Polymers to Enhance the Performances of Lithium-Ion Batteries" Nat. Energy, 8, 129. (2023).



Development of scalable synthetic recycling strategies for lithium iron phosphate cathodes.



Development of hydrogel electrolytes for low-temperature energy devices (-60 °C).



Investigation of mixed ionic-electronic conducting mechanisms in synthetic polymers

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