Graduate Studies in Engineering and Computer Science at the University of Central Florida

Department of Materials Science and Engineering

Department of
Materials Science and Engineering (MSE)

Faculty and Students	Faculty	Joint Faculty	Doctoral Students	Master Students
Number	**14**	**28**	**44**	13

Research Areas:

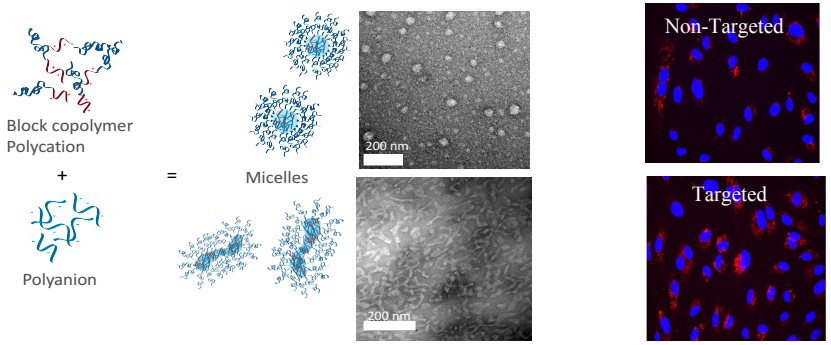
- Electronic, biological, novel, structural and nano-materials
- Semiconductor interconnects
- Magnetics
- Organic and molecular engineering
- Bioengineering
- Shape-memory alloys

Facts of Interest:

- Chair Sudipta Seal is a member of the National Academy of Inventors and holds close to 65 patents
- 4 newest faculty are part of clusters for interdisciplinary research with specializations in energy and prosthetics

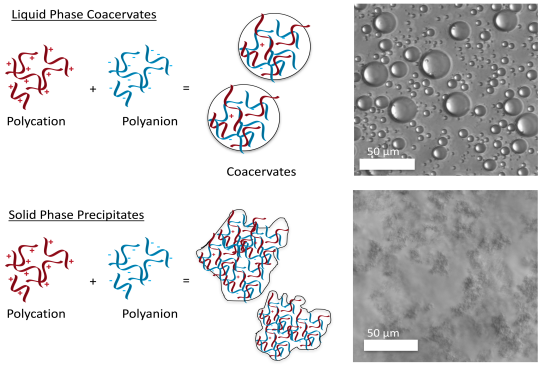
Peptide Based Materials

Nanoscale Delivery Vehicles



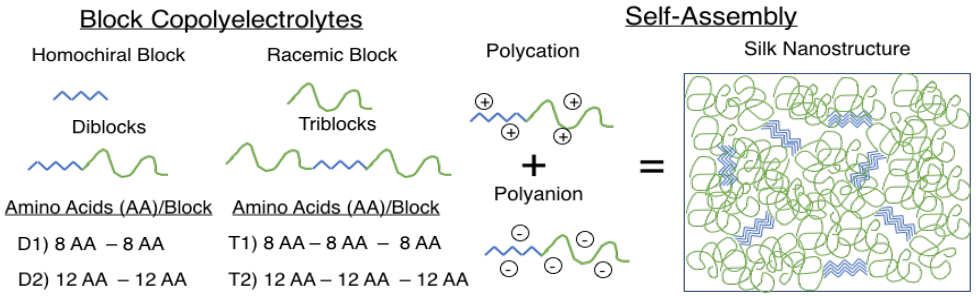
Designing Delivery Vehicles for Nucleic Acids & Proteins
Next Direction: Dynamic Thermosensitive Coronas

Polyelectrolyte Complexes



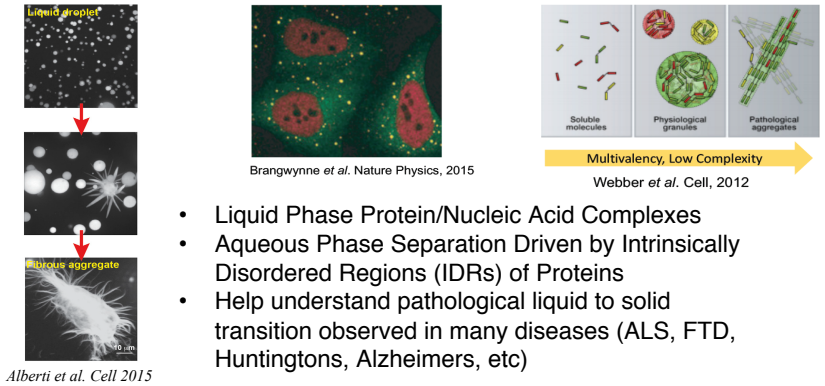
Unraveling Phase Behavior of Polyelectrolyte Complexes
Next Direction: Role of Hydrophobicity in Encapsulation

Silk Mimetic Materials



Creating Silk Nanostructure using Simpler Amino Acid Sequences
Next Direction: Synthesis and Characterization

Membraneless Organelles



Alberti et al. Cell 2015

- Liquid Phase Protein/Nucleic Acid Complexes
- Aqueous Phase Separation Driven by Intrinsically Disordered Regions (IDRs) of Proteins
- Help understand pathological liquid to solid transition observed in many diseases (ALS, FTD, Huntingtons, Alzheimers, etc)

Designing Biomimetic Sequences to mimic IDRs
Next Direction: Reversible Phase Separations

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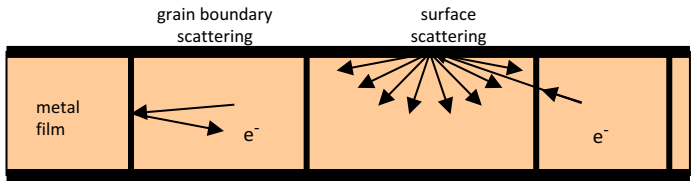
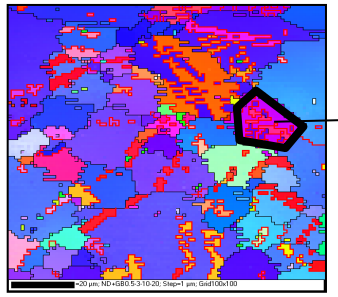
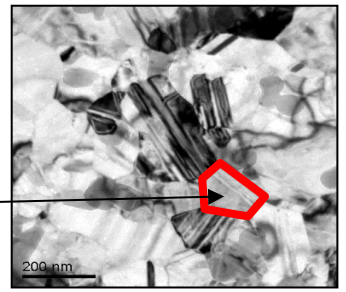
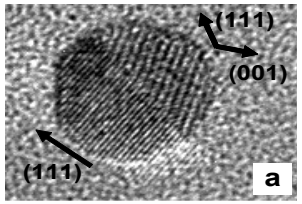
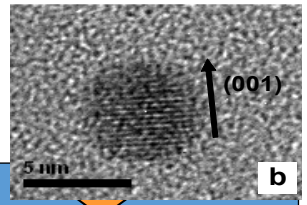
K.R. Coffey – Thin Film Materials

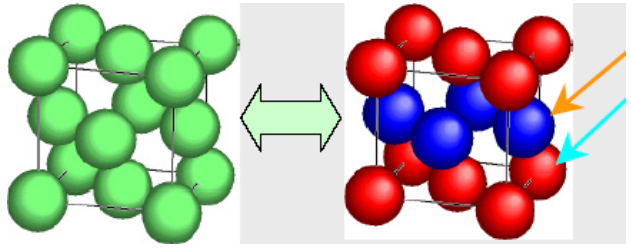








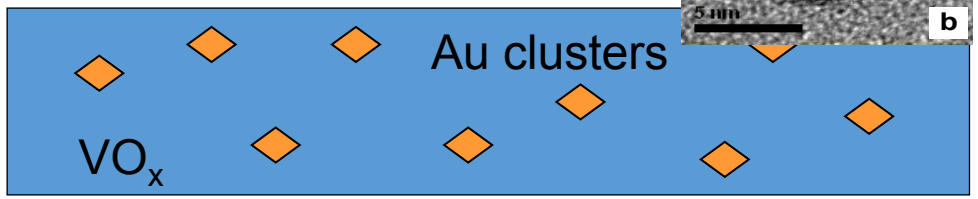




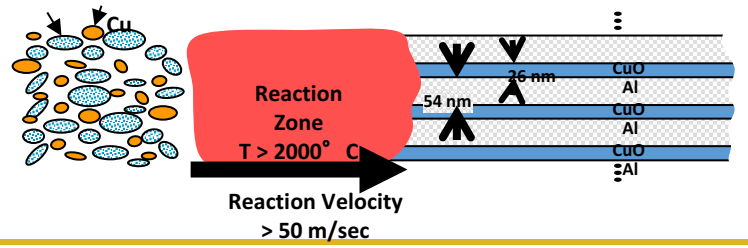
Metals: ; Co, Ni, Ru, and W as future interconnect materials ; TEM and X-ray metrology

Nano: Chemical ordering of intermetallic nanoparticles

Semiconductors:
VO_2 optical materials; Amorphous VO_x IR sensors,



Energy: Li solid-state battery materials



Energetics: PVD nano-composite thermites

DAVIS RESEARCH GROUP

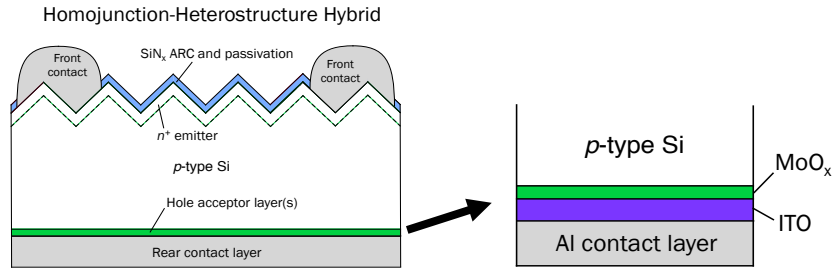
Powered by SunShot U.S. Department of Energy

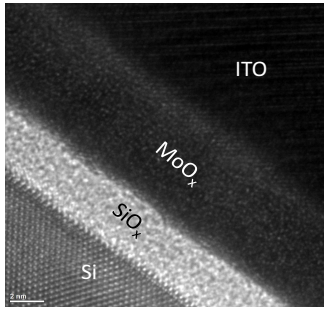
Focus. Develop manufacturing processes and characterization techniques for the photovoltaic (PV) industry to help accelerate the adoption of solar.

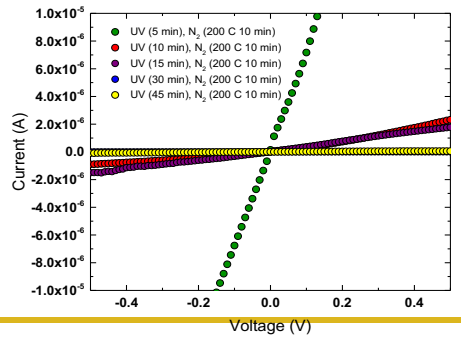
Project Examples

Hole-Selective, Passivated Contacts using High Work Function Metal Oxides

Funding: U.S. Department of Energy

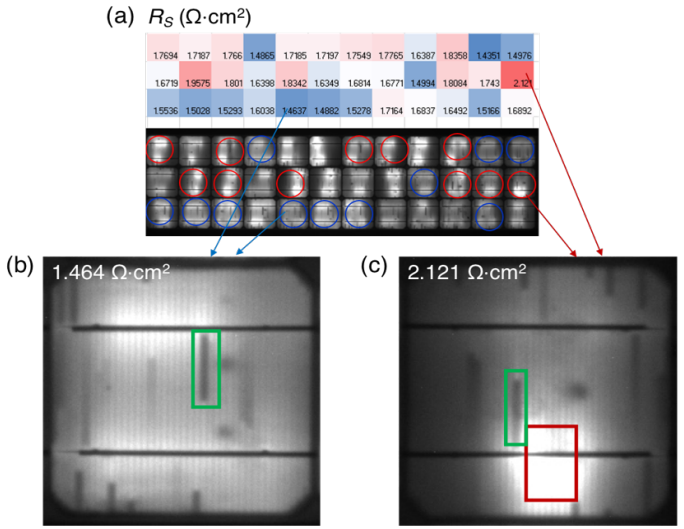






Characterization of Contact Degradation in PV Cells and Modules

Funding: U.S. Department of Energy



Dark rectangles = disconnected front cell contacts

Bright regions near busbar = highly resistive module interconnects

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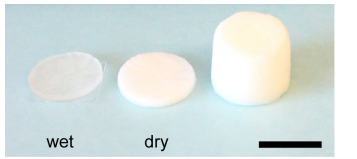
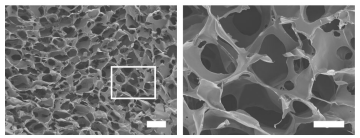
Biomaterial Scaffolds as Research Platform: S. Florczyk

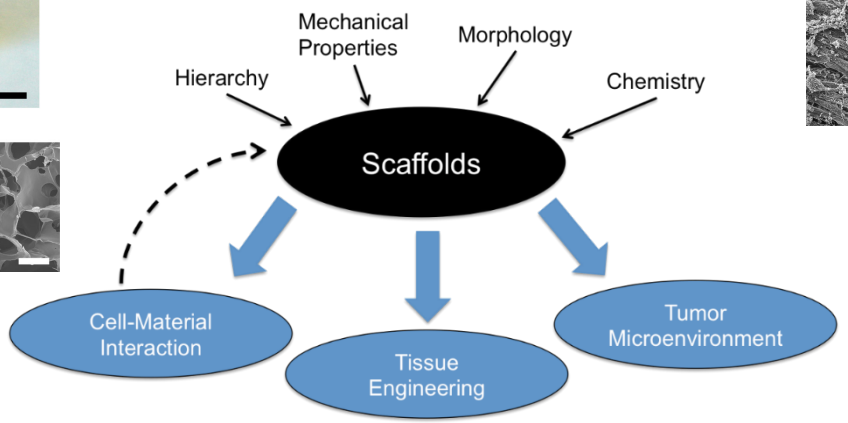
Biomaterial scaffolds produced with ability to tailor scaffold properties to application.

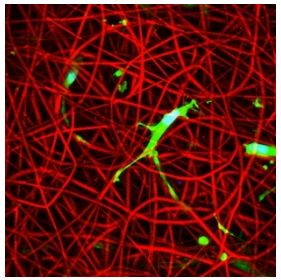
Scaffolds primarily prepared from natural polymers or ceramics.





Chitosan-hyaluronic acid (C-HA) 3D porous scaffolds.



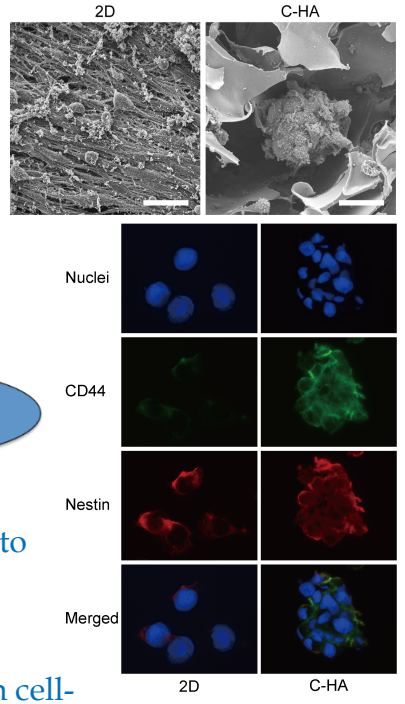


Stem cells (green) on polymer microfibers (red) to study cell-material interaction.

Approach: Use biomaterial scaffolds as a platform to explore biomedical questions.

Projects

- Effect of diabetic and obese stem cell donors on cell-material interaction.
- Interaction between cancer and stem cells.



Cancer cells on C-HA scaffolds form tumor spheroids instead of flat monolayers on 2D surface (top) and are more malignant. This allows for better cancer models for drug testing.

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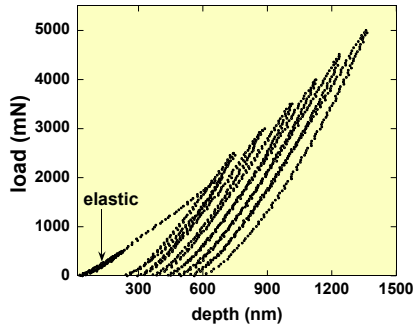
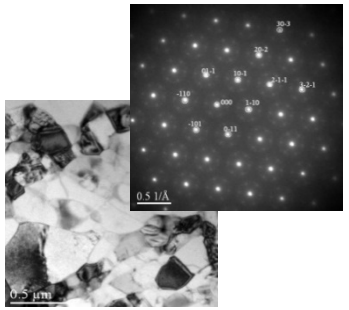
Research in Shape Memory Alloys
PI: Raj Vaidyanathan

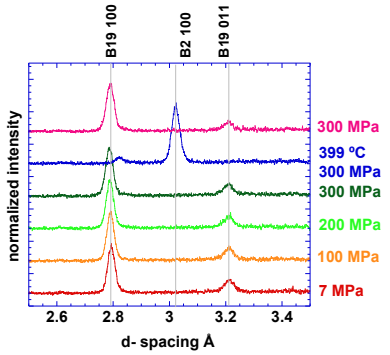
PROPERTY
- DSC, DMA, dilatometry
- Nanoindentation
- Mechanical testing

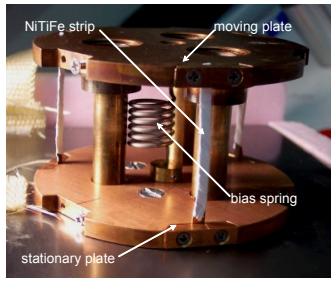


STRUCTURE
- FIB, HRTEM, SEM, etc.
- *in situ* neutron diffraction at Los Alamos and Oak Ridge National Laboratories

PROCESSING
- Arc melting
- Thermomechanical treatments
- Actuator development



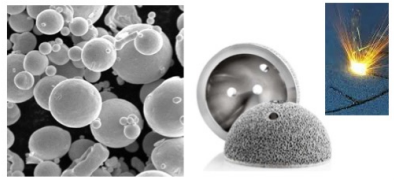




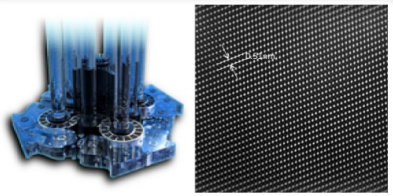
Laboratory of Materials and Coatings for Extreme Environment - MCEE

SOHN Materials Research Group
http://mse.ucf.edu/sohn/

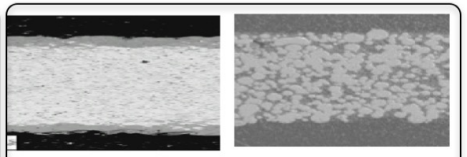
Gas Atomization Metallic Powder Processing for Powder Bed Fusion Agile and Additive Manufacturing



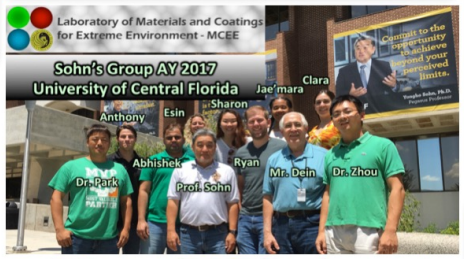
High Throughput Development of Thermodynamics and Diffusion Kinetics Database for Materials by Design

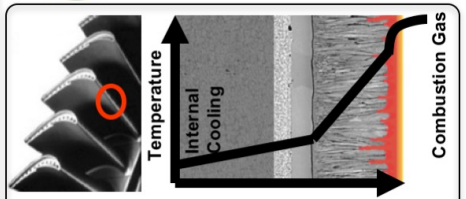


Neutron Irradiation Enhanced Atomic Diffusion under Temperature Gradient for Advanced Metallic Nuclear Fuels @ INL Adv. Test Reactor

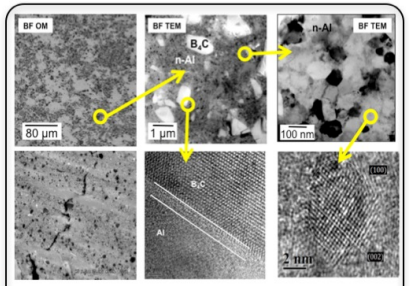


Low-Enriched Metallic Nuclear Fuels for Research Reactors and Non-Proliferation

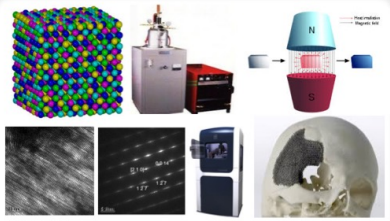




Gas Turbine Components and Thermal Barrier Coatings



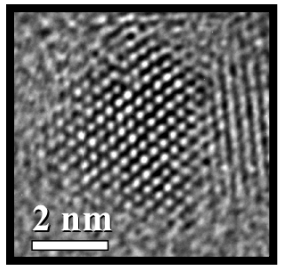
Metallic Alloys and Multiscale Composites:
Magnesium and Aluminum for Automotive and GCVs
Tungsten for Kinetic Energy



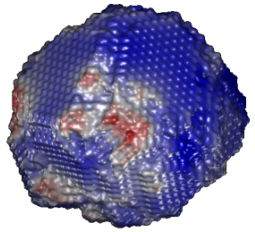
Multifunctional and Multicomponent alloys:
High Entropy; Thermoelectric; Magnetocaloric; Bulk Metallic Glasses; Biomaterials

Nano-Bio-Manufacturing

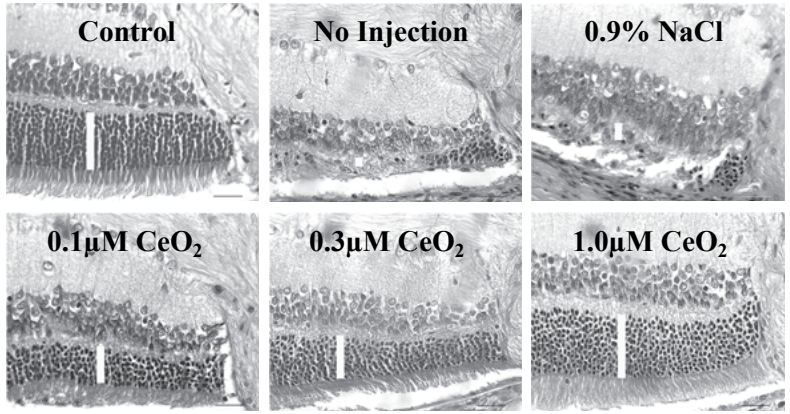
Regenerative Bio-nanomedicine



Experimental

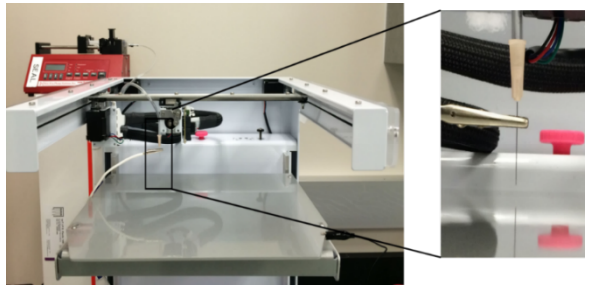


Modelling: Biomaterials

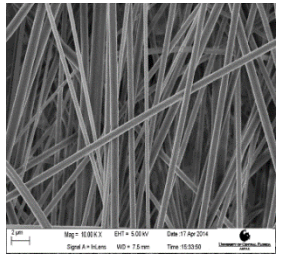


Biomedical Applications, Nature Nanotech, 2006

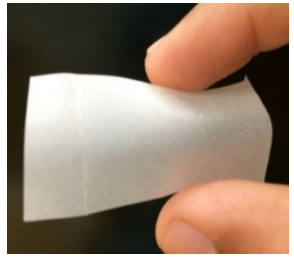
Smart Flexible Theranostics Patch



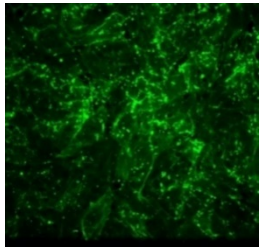
Electrospinning+3d Printer



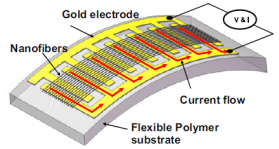
Silk + nanoCeria+Add



Patch - Flexible



Biocompatible



Future Sensor

Others: Nanoenergetics, Additive Manufacturing, Coatings, Green Ceramics

Sudipta Seal: Surface Engineering and Nanotechnology

Hybrid Materials/Devices & Nanocharacterization

Soft Materials for Smart Devices at the Human Interface

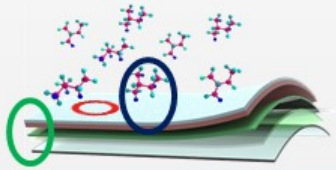
Kaitlyn E. Crawford

Interfacial Properties

Surface-Surface

Intermolecular

Analyte-Surface



Biomaterials and Therapeutic Interfaces

Elizabeth J. Brisbois

Development Phase
- Drug Delivery
- NO Donor Synthesis
- Immobilization
- Bioabsorbable Materials
- Electrospinning
- Microspheres
- Electrochemistry
- Sensors

Testing Phase
- NO Release
- Surface/Physical Properties
- Sterilization/Storage
- Antibacterial Testing
- ISO Biocompatibility
- Blood Compatibility
- Animal Models

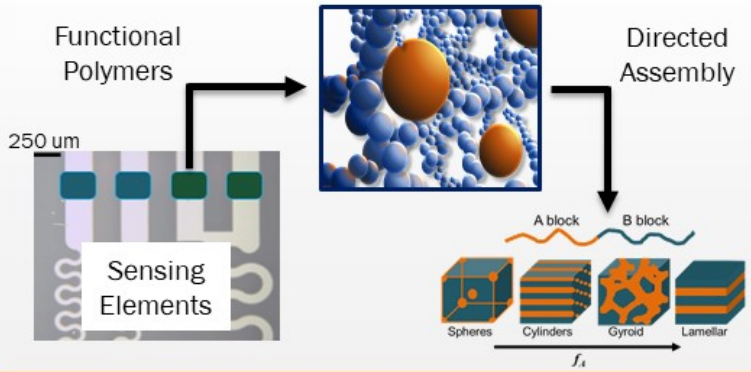
Clinical Applications

Partners: MC3 and Biocrede, Inc.

Translational Research

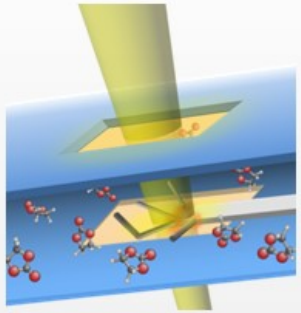
Interfacial Properties of Soft Functional Materials

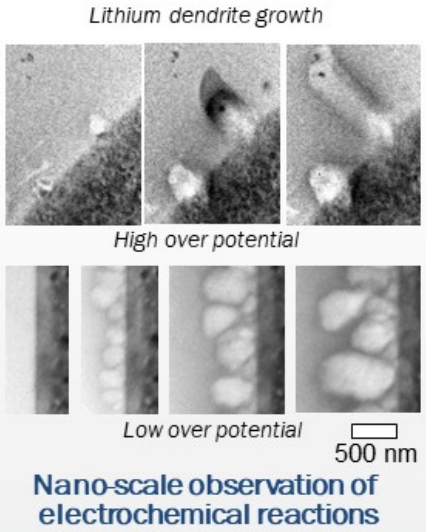
Kaitlyn E. Crawford



In-situ Liquid Cell Transmission Electron Microscopy

Akihiro Kushima





Nano-scale observation of electrochemical reactions

After Graduate School

Our graduate students find employment in several areas:

- Industry Careers (Micron, Siemens, Lockheed Martin, etc.)
- Startups and Commercialization of Research
- Faculty Appointments at the University level
- Post Doctorate Appointments