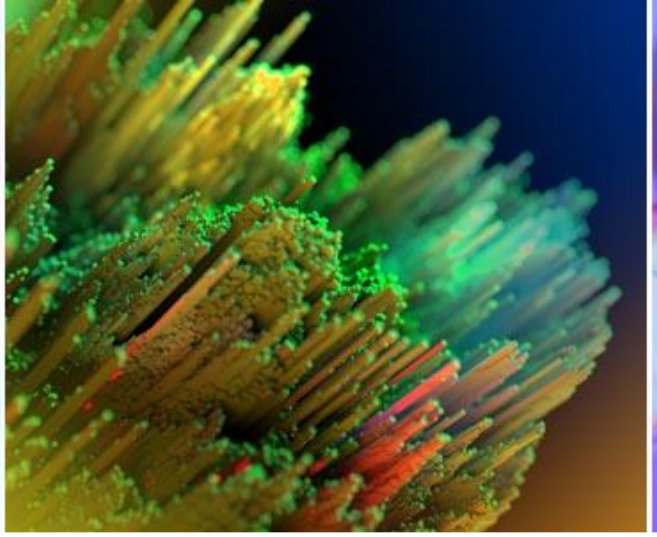




Department of Engineering Science and Mechanics

GRADUATE PROGRAMS

- Ph.D. in Engineering Science and Mechanics
- M.S. in Engineering Science and Mechanics (*Thesis and Non-Thesis Tracks)*
- M. Eng. in Engineering Mechanics
- M.D./Ph.D.
- M.S. in Engineering at the Nanoscale

PennState
College of Engineering

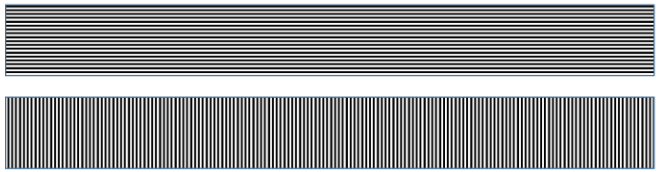
Mechanical anisotropy of 3D printed composite

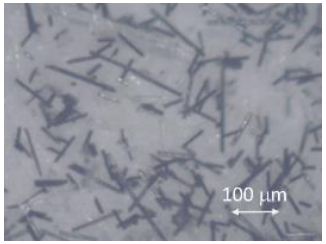
Below: Carbon whisker composites manufactured through fused filament deposition

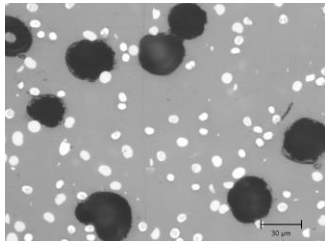
3D Printer
(fused filament deposition)

Printing Head

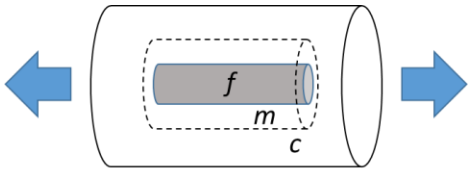
Flat Unidirectional Specimens







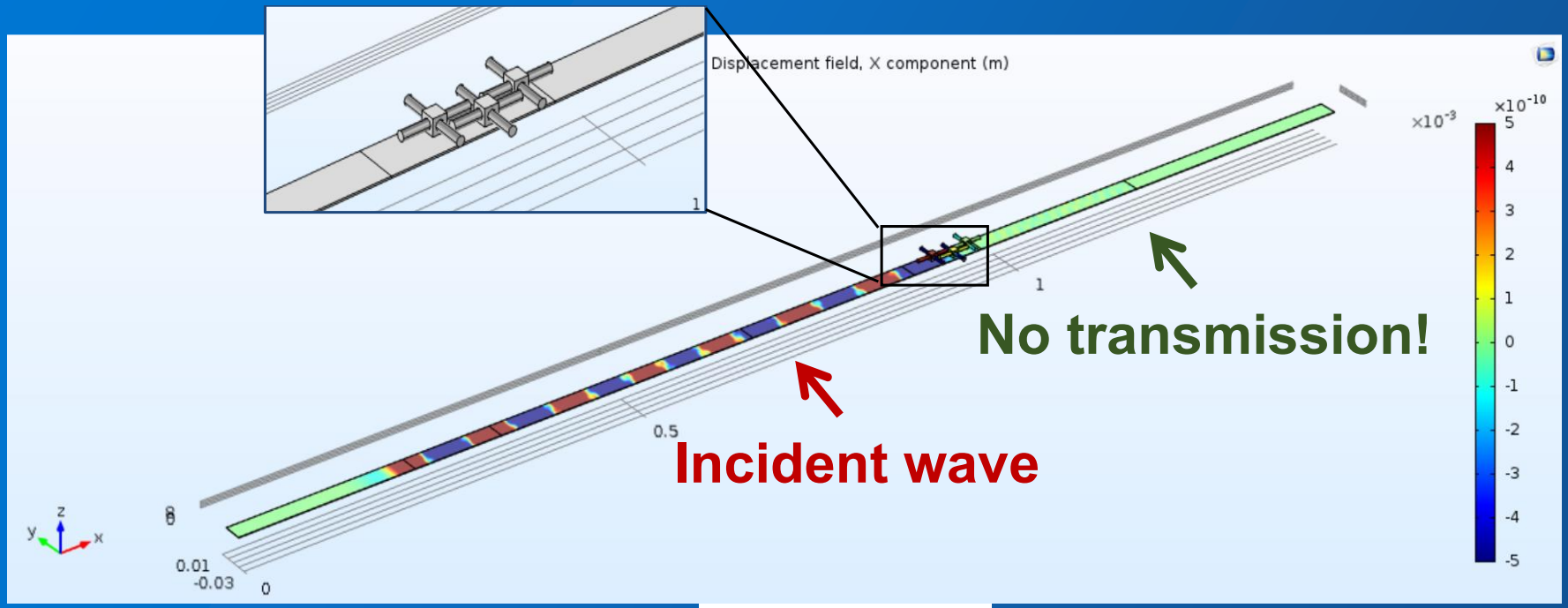
Whisker and void morphology



Micromechanical
modeling

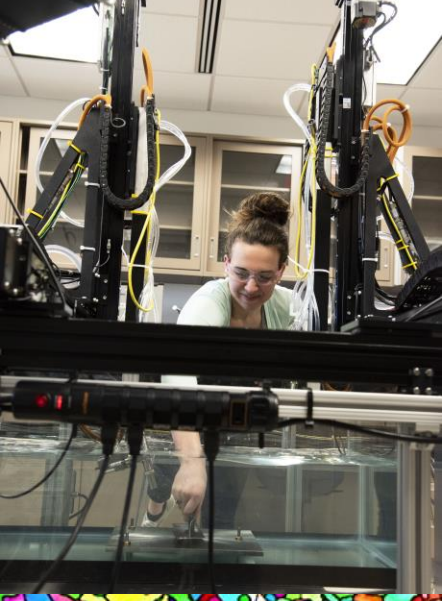
PI: Dr. Charles Bakis

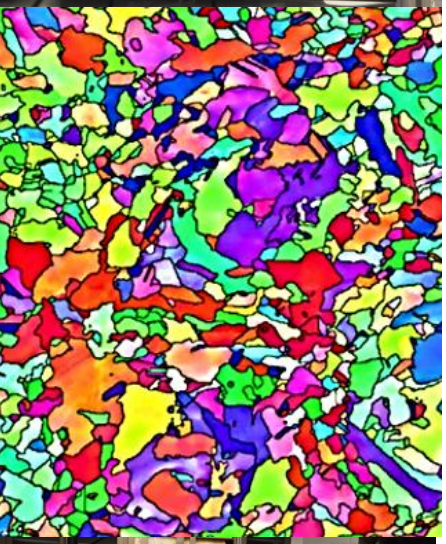
Mechanical anisotropy of 3D printed composite



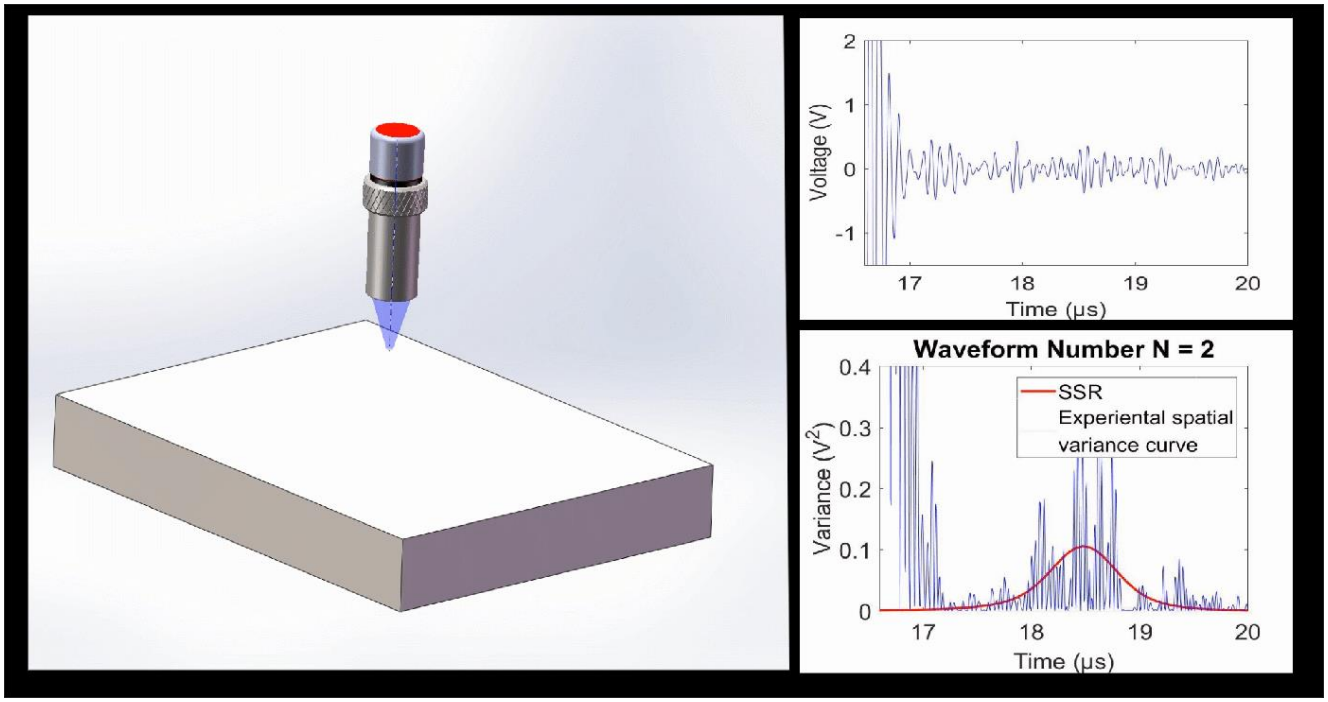
Above: A set of resonators mounted on a plate reflect the incident wave

PIs: Drs. Shokouhi & Lissenden





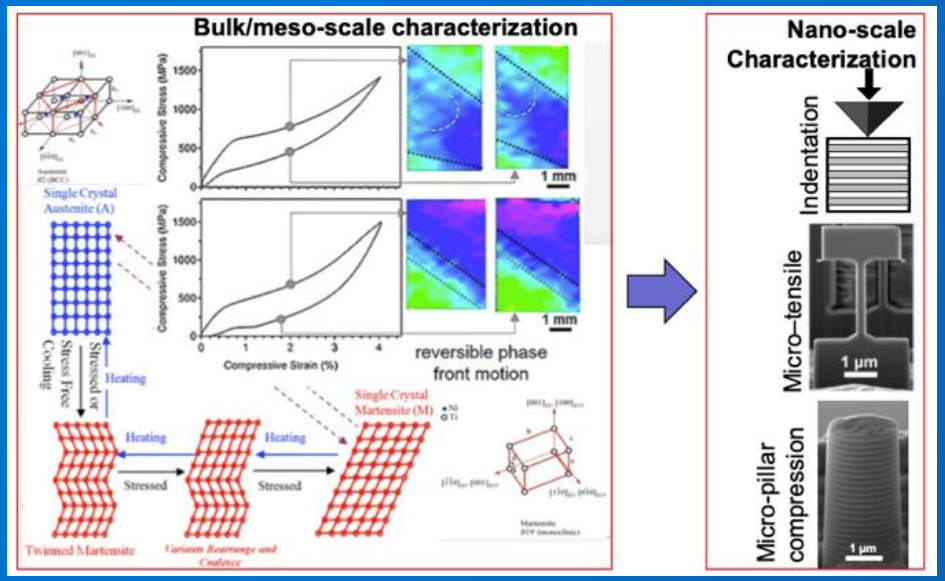
Ultrasound allows nondestructive microscale characterization

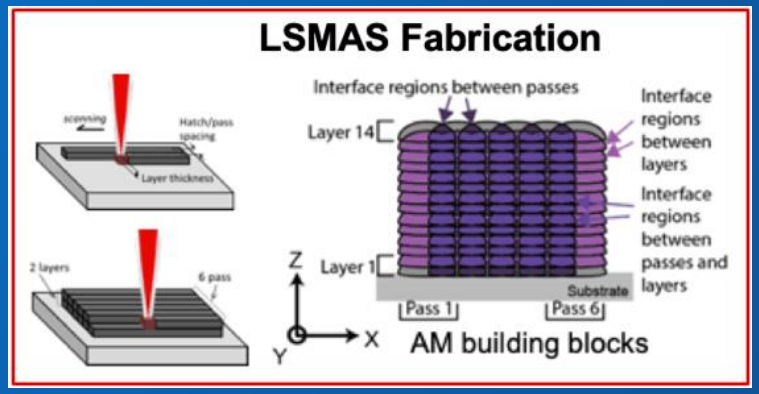


Above: Defect detection in metallic alloy; polycrystalline microstructure and corresponding ultrasonic scattering signals.

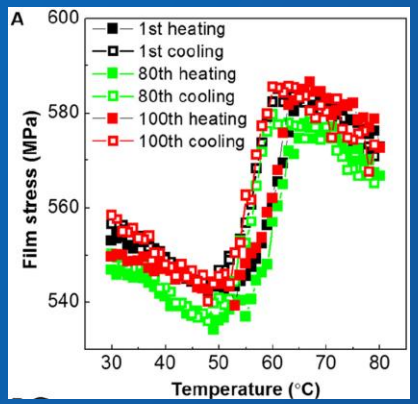
PI: Dr. Andrea P. Arguelles

Additive manufacturing of shape memory alloys (SMAs)

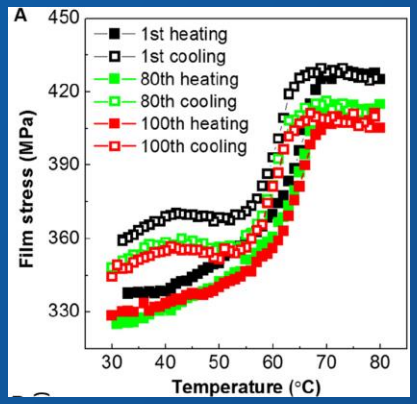




$Ni_{49.7}Ti_{50.3}$



$Ni_{50.3}Ti_{49.7}$



Above: Hierarchical SMA structures; nano-/micro-/meso-scale test approaches to locally probe deformation mechanisms; performance of two compositions

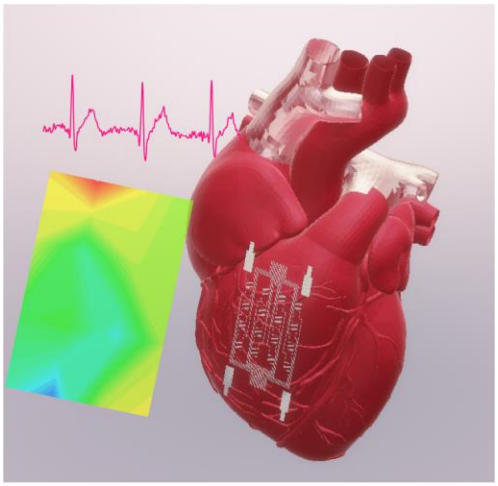
PI: Dr. Reginald Hamilton

Department of Engineering Science and Mechanics

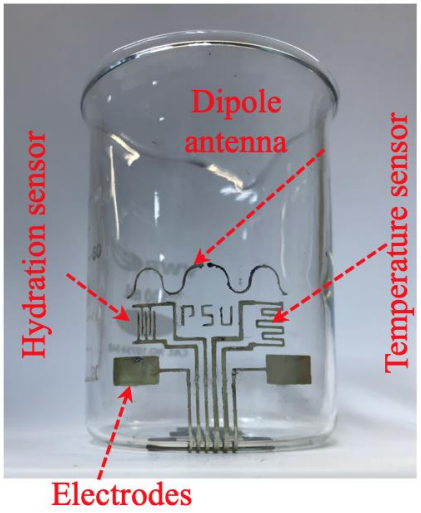
PennState College of Engineering

Wearable and Degradable Devices

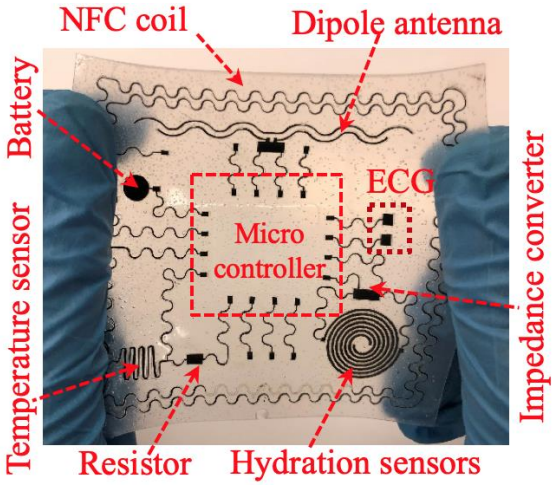
Transient implantable devices



3D degradable electronics

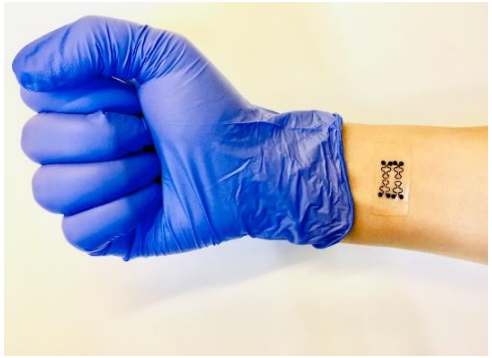


Integrated system



Above: Transient Sensor on Low-Cost Substrate for Implantable devices; Fully degradable 3D Electronics on Curvilinear Surfaces.

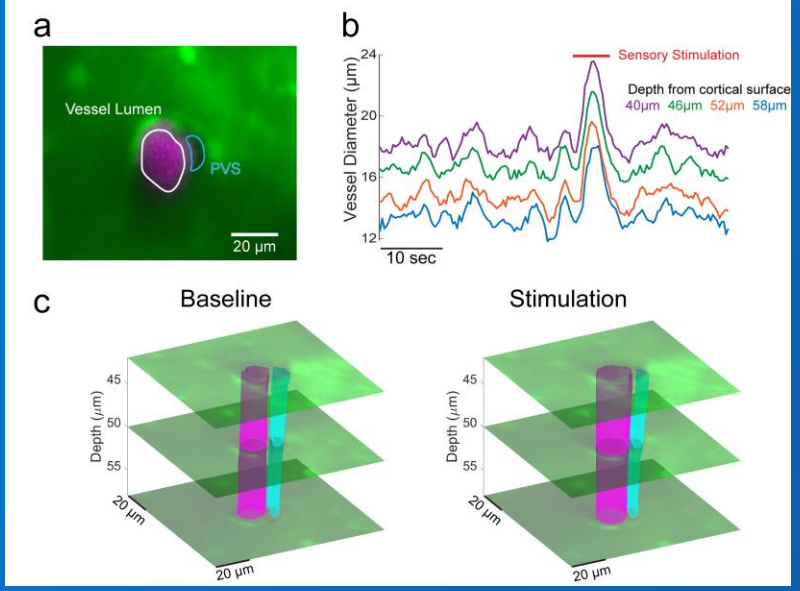
Skin-conforming

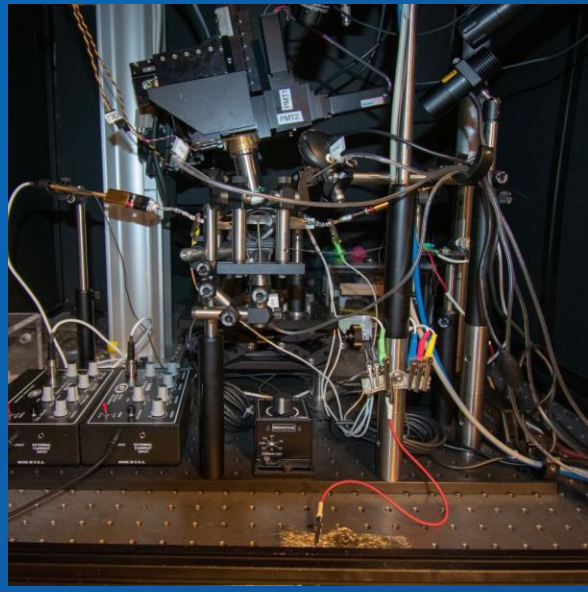


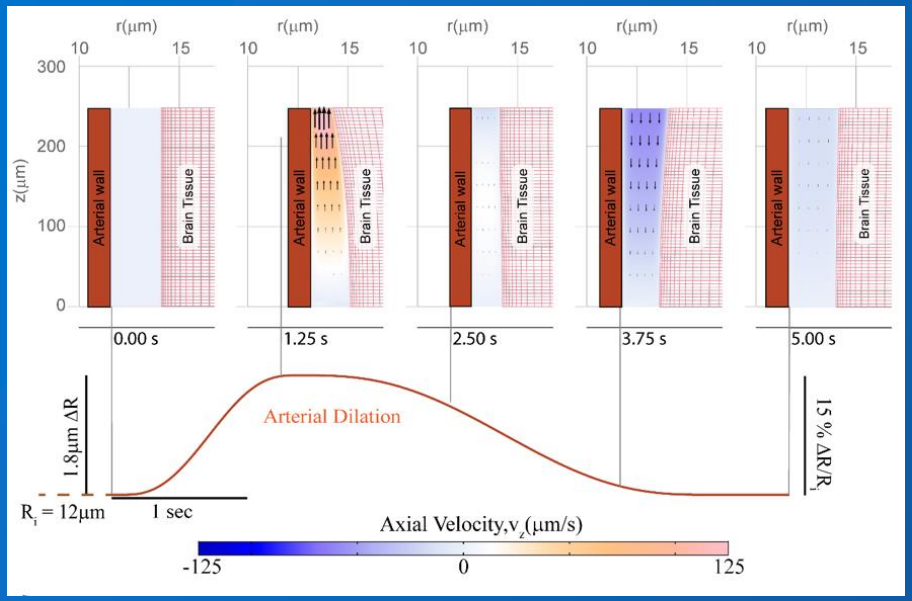
Energy harvesting

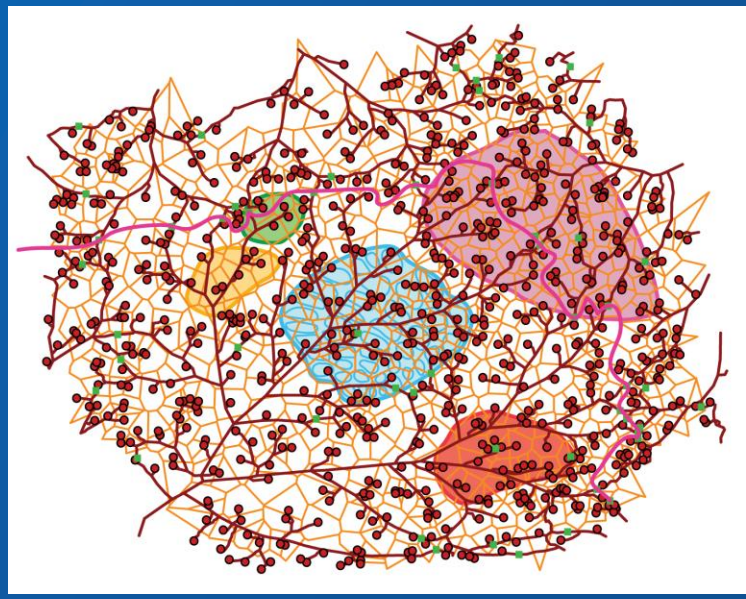
PI: Dr. Larry Cheng

Understanding the neural control of blood flow and fluid movement in the brain using optical imaging and modeling.





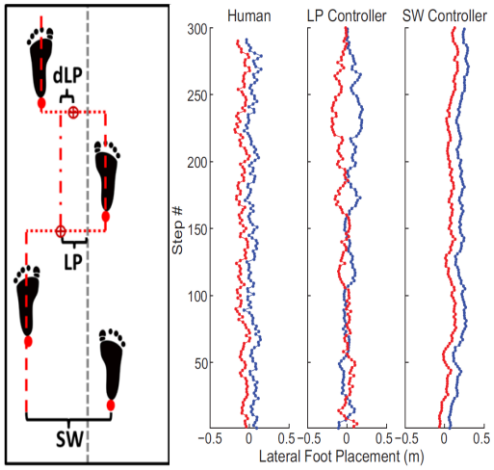


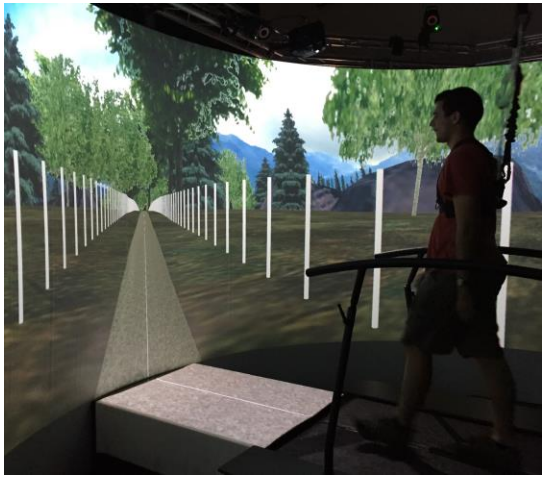


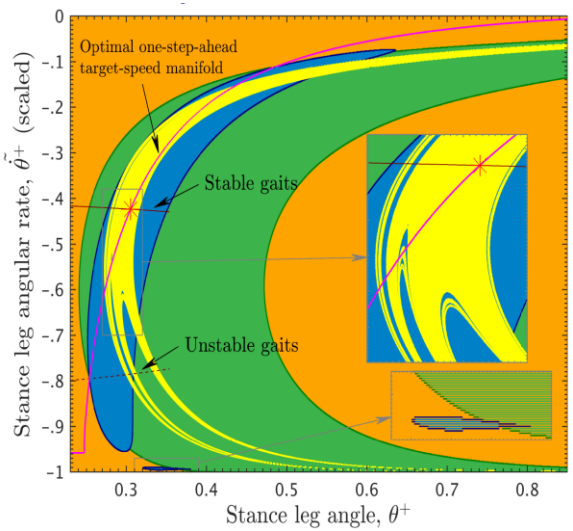
drew-lab.org

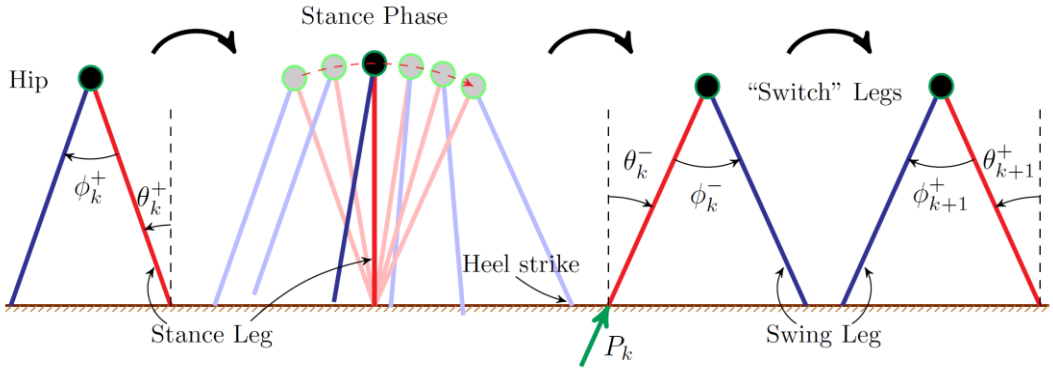
PI: Dr. Patrick Drew

Dynamics, stability, and control of human walking





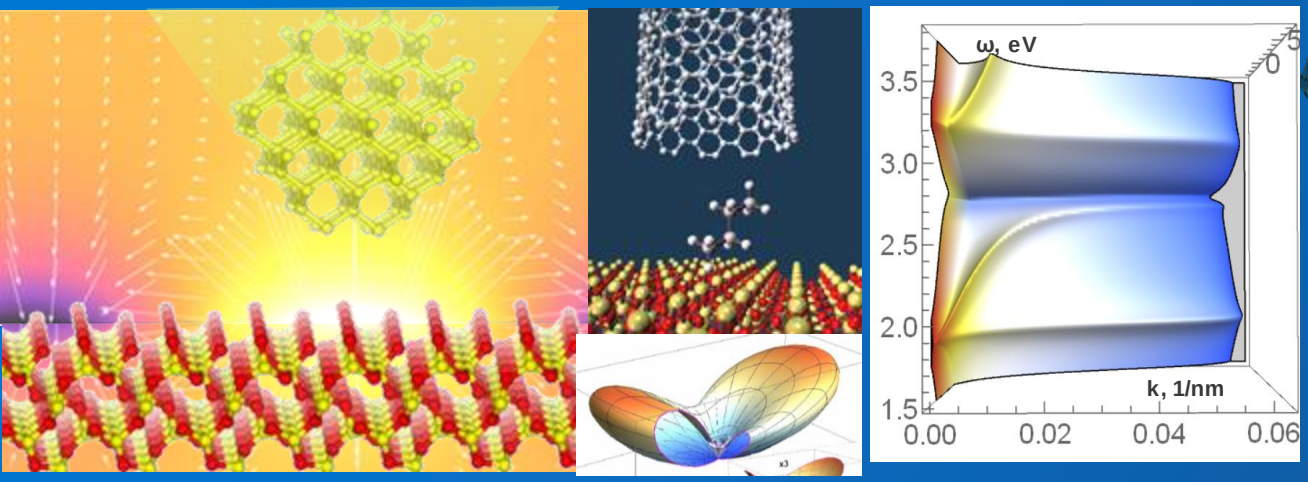




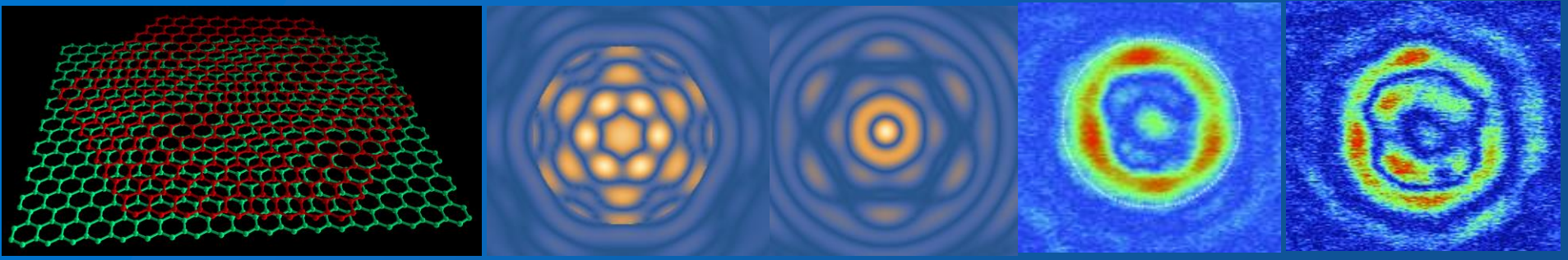
Above: Experimental measurements of stepping behavior used to develop models to test theories of motor regulation and design interventions to mitigate fall risk

PIs: Drs. Cusumano & Dingwell

Theory of Nanoscale Plasmonic Materials



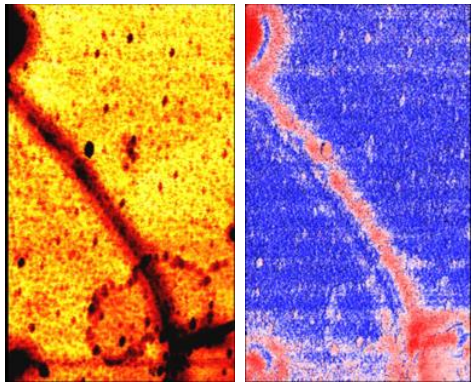
Examples of modeling of nanoscale antennas (near-field tip, nanotube polariton).



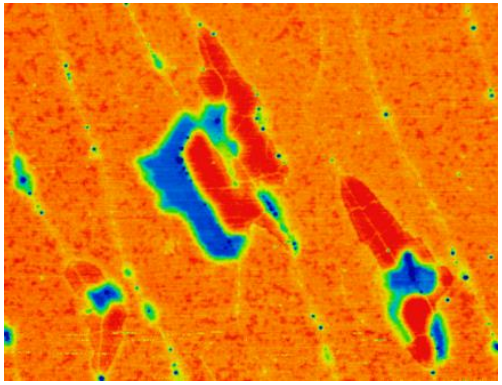
Theoretical vs. experimental maps of twisted graphene plasmonic disk.

PI: Dr. Slava Rotkin

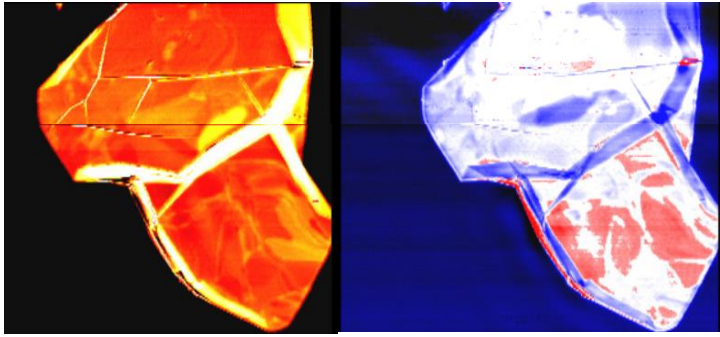
Nanophotonics characterization of 2D- and Bio-materials



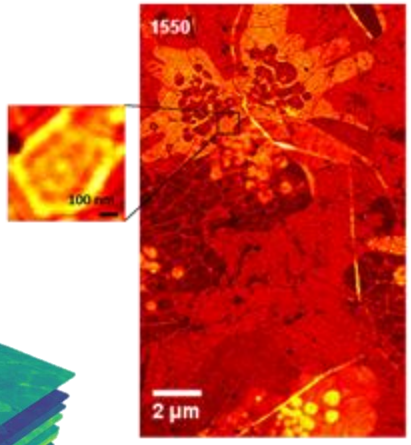
viral particles

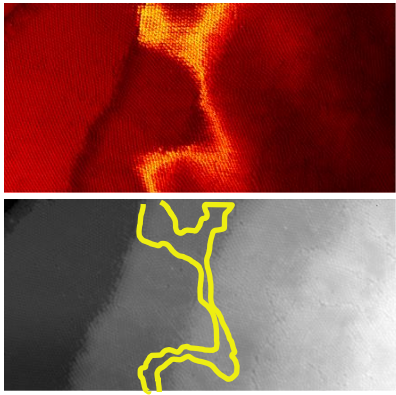


polar 2-dimensional metal (Indium)



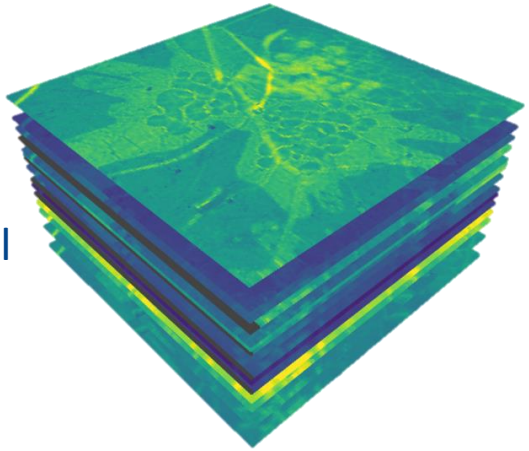
Multilayer twisted graphene: exfoliated and CVD crystals; sub-um plasmonic compartment





photonic crystal

Maps taken by scattering Scanning Near-field Optical Microscope on different materials, revealing material properties with sub-diffractional resolution



PI: Dr. Slava Rotkin

Materials for MRI and 5G

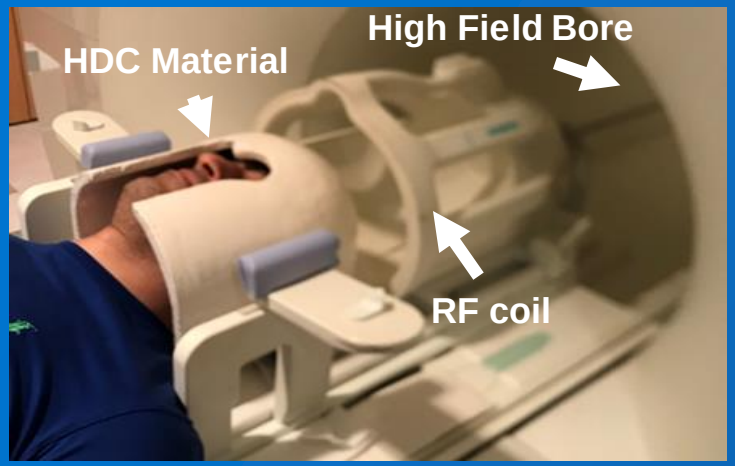
Permittivity
Permeability
Conductivity

ELECTROMAGNETIC SIMULATION
FDTD, MoM, FEM

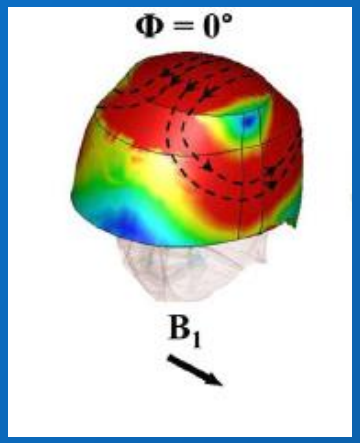
Integration
Tractable
Fabrication

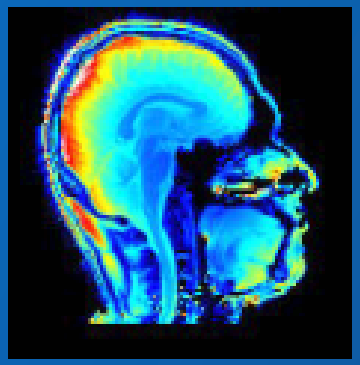
MATERIALS
Properties and Processes

DEVICES
Antennas, Filters, MRI

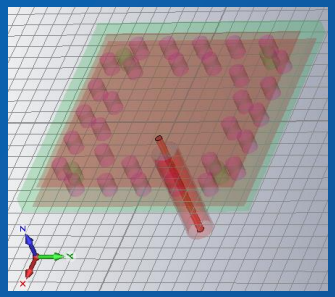


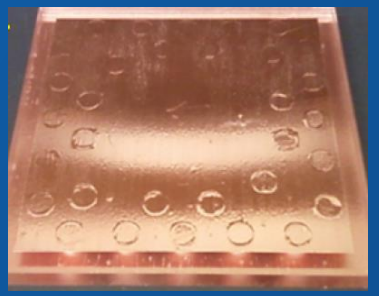
Dielectric Helmet with High Permittivity Material

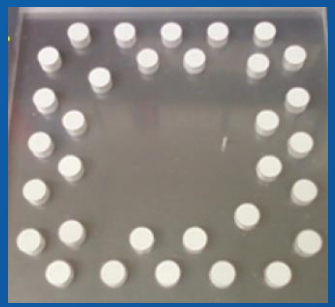




Simulated and measured electromagnetic fields in human head at MRI frequency





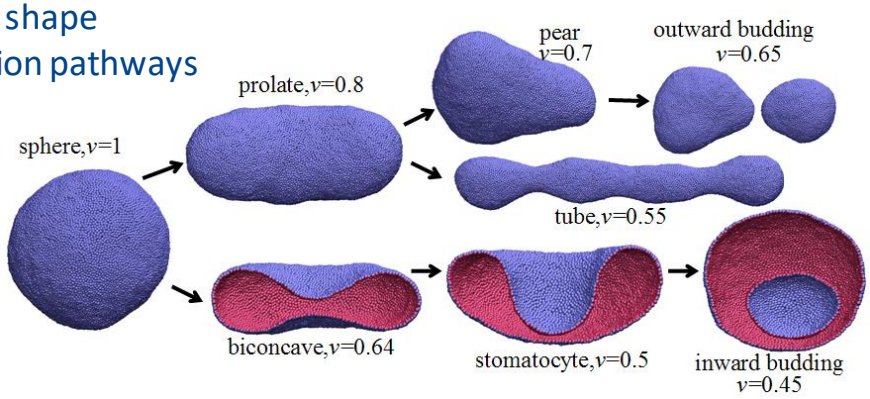


5G antenna structures with high permittivity materials

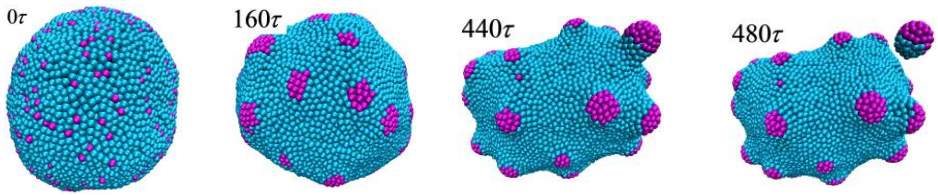
PI: Dr. Mike Lanagan

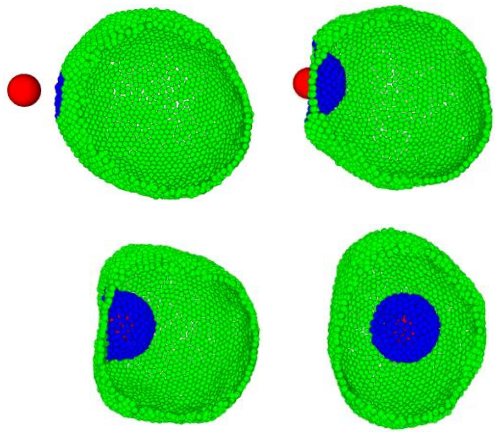
Biomembranes and membrane-mediated processes

vesicle shape transition pathways



two-component vesicle phase dynamics: demixing, coarsing, budding



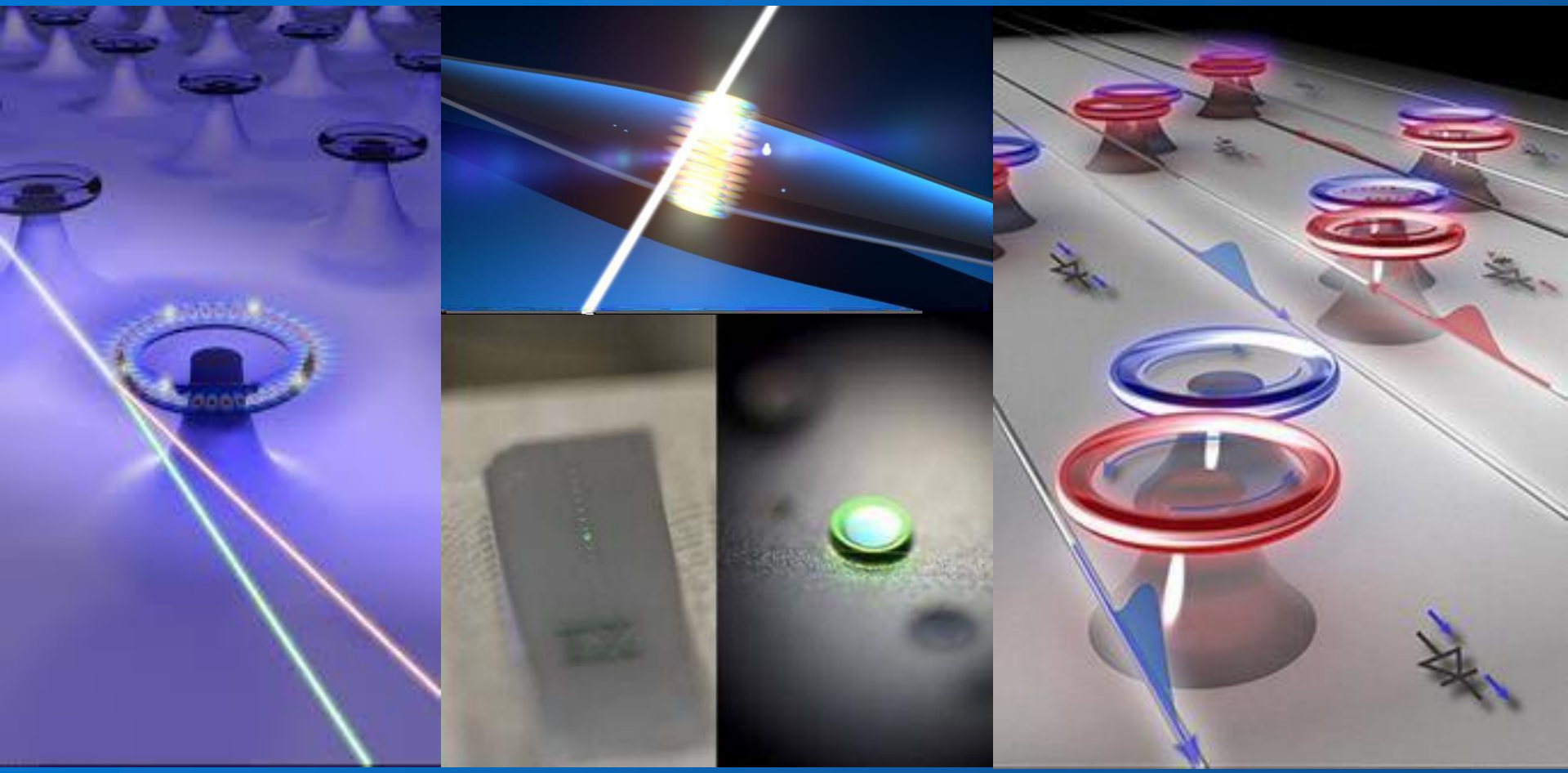


endocytosis of nanoparticles

Above: Coarse-grained modeling of: vesicle shape transition pathways; two-component vesicle phase dynamics; Drug or DNA delivery via nanoparticles

PI: Dr. Sulin Zhang

Doing optics at the exceptional points



From optical sensing to control of light propagation

PI: Dr. Sabin Ozdemir

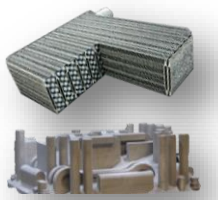
Department of Engineering Science and Mechanics

PennState
College of Engineering

Additive manufacturing of metals for energy applications

Rethinking Materials for the Energy Sector Through Additive Manufacturing

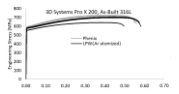
Powder Bed Fusion



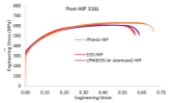
Directed Energy Deposition

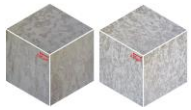
Images courtesy of CIMP-3D

Austenitic Stainless Steels



PBF Optical Micrographs (As-Built)
Pro X 200 EOS M280

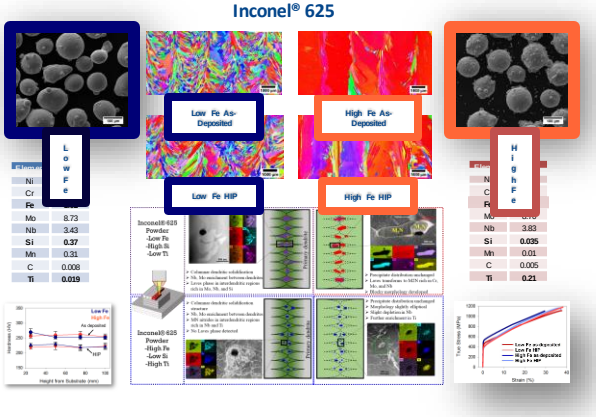




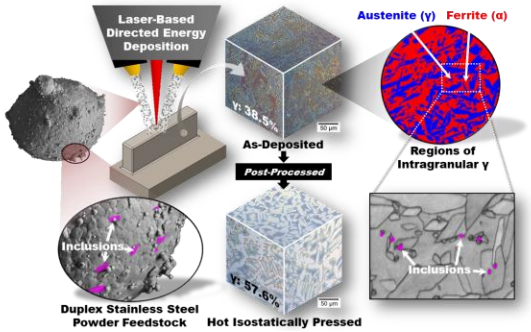
PBF Optical Micrographs (Post-HIP)
EOS N2-Atomized EOS Air-Atomized

Nickel Based Alloys

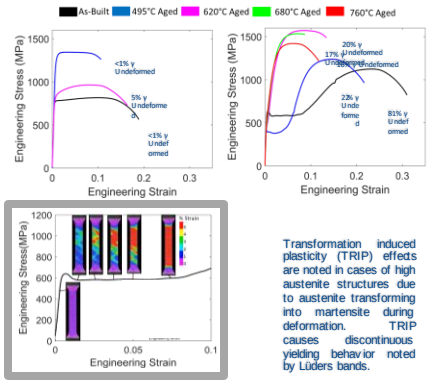
Inconel® 625



Duplex Stainless Steels



Precipitation Hardened Stainless Steels

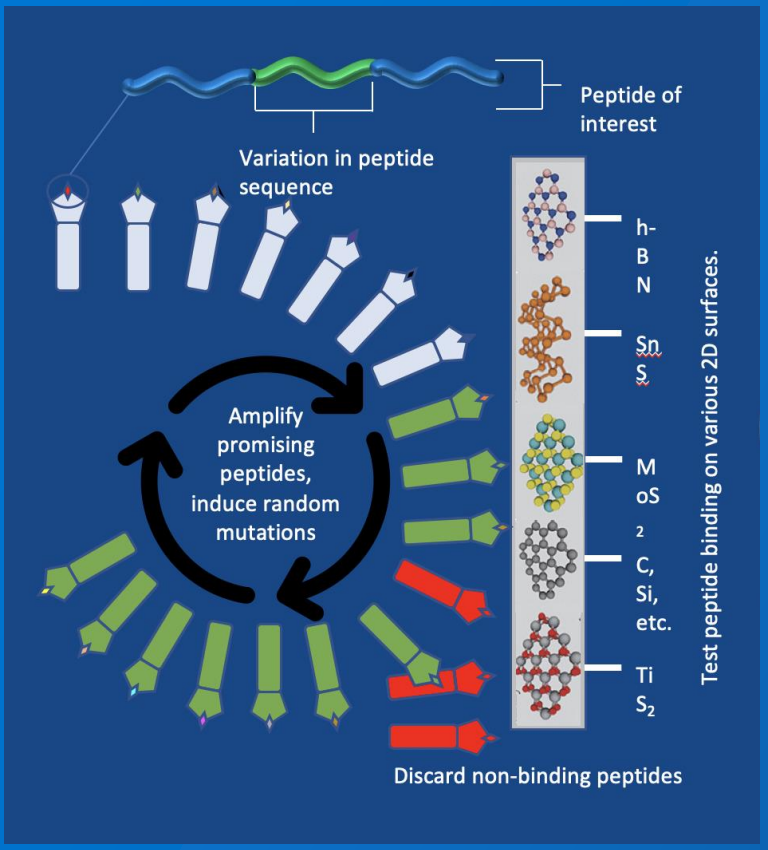


Transformation induced plasticity (TRIP) effects are noted in cases of high austenite structures due to austenite transforming into martensite during deformation. TRIP causes discontinuous yielding behavior noted by Lüders bands.

Above: Solutions for the energy sector through additive manufacturing and repairs of corrosion resistant, high strength, and creep resistant materials.

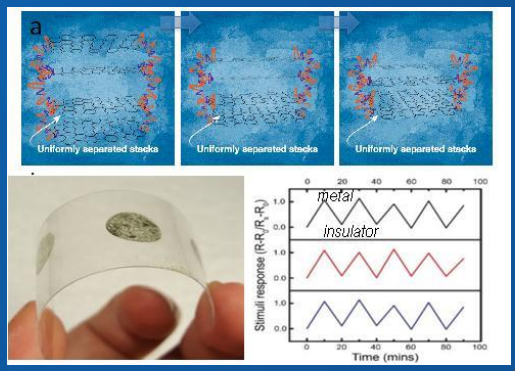
PI: Dr. Todd A. Palmer

Theory-driven functional materials synthesis and fabrication to produce next generation materials by merging synthetic biology and materials science



Molecular Design

Molecular Inspiration



Molecular Composites

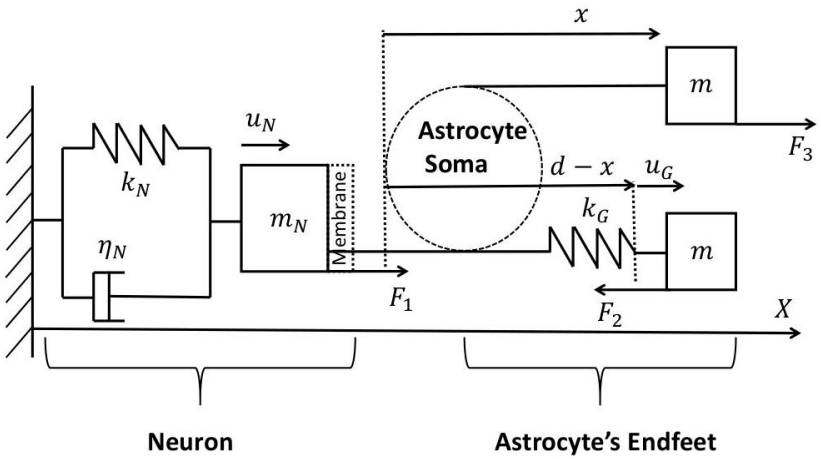
Above: From self-assembly to molecular composites

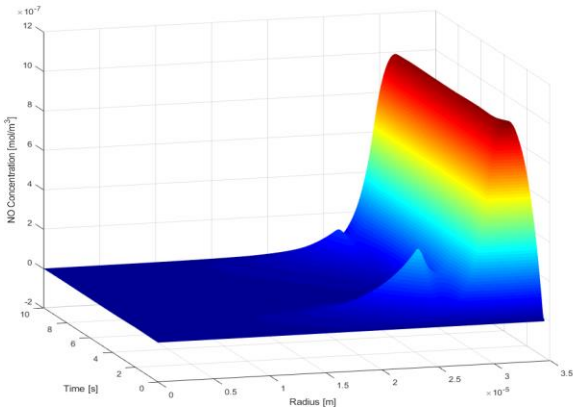
PI: Dr. Melik Demirel

Department of Engineering Science and Mechanics

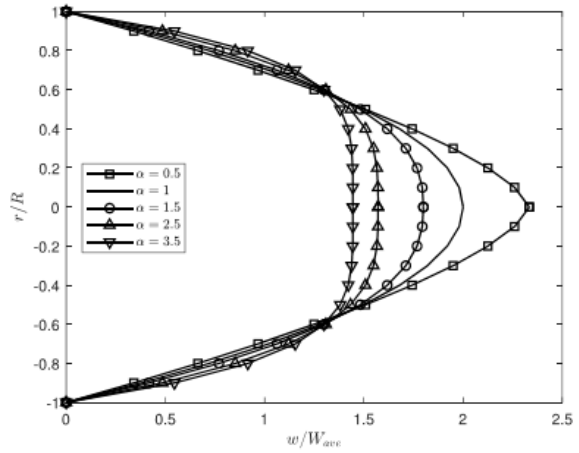
PennState
College of Engineering

Mathematical models of brain-on-a-chip and brain's non-locality

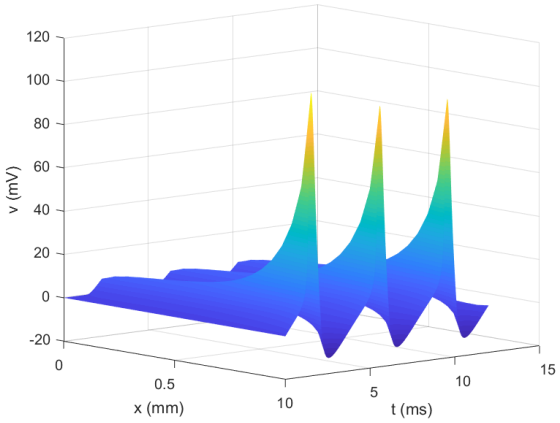




Nitric Oxide Mechanotransduction in Brain



Non-local Blood Flow

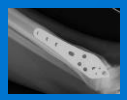
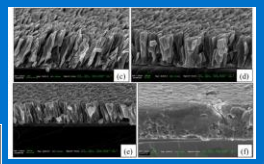
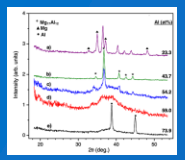


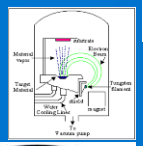
Non-local Action Potential

Above: Design of a brain-on-a-chip, mechanotransduction and non-locality

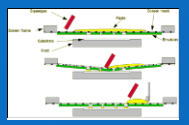
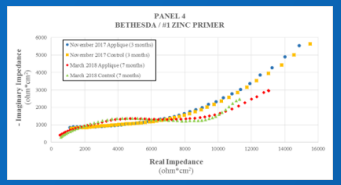
PI: Dr. Corina Drapaca

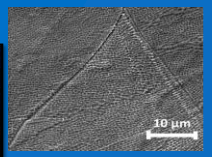
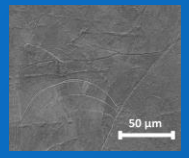
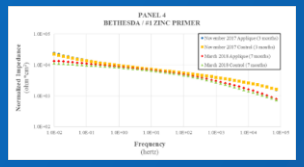
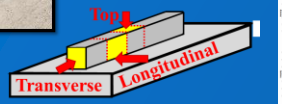
Environmental Degradation

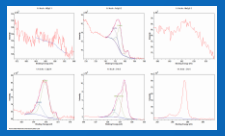









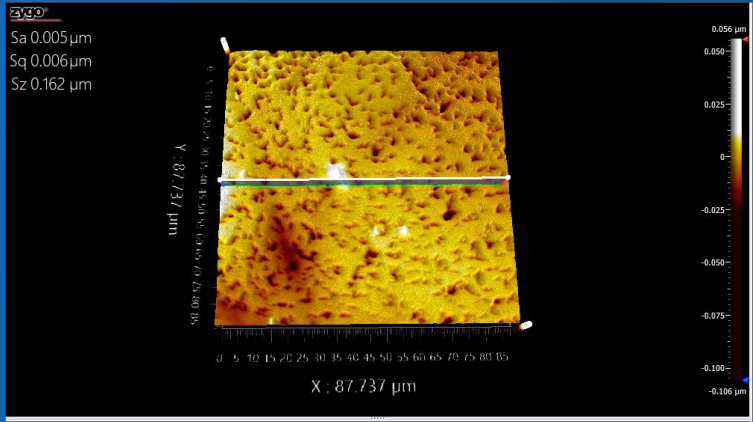





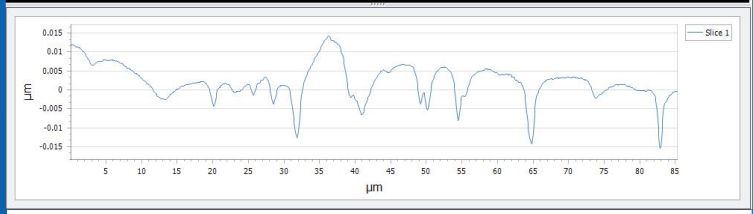


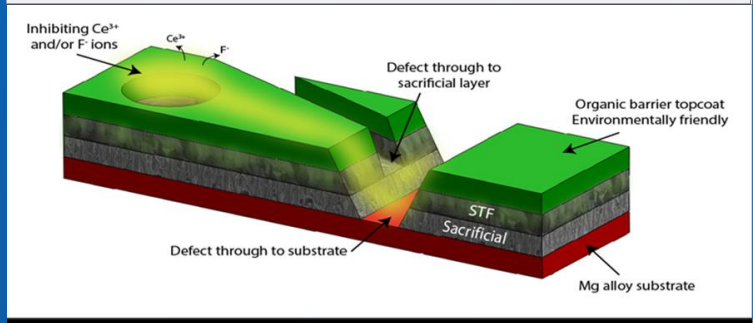
*An array of sensors could be used to sense **degradation occurring in a large space***

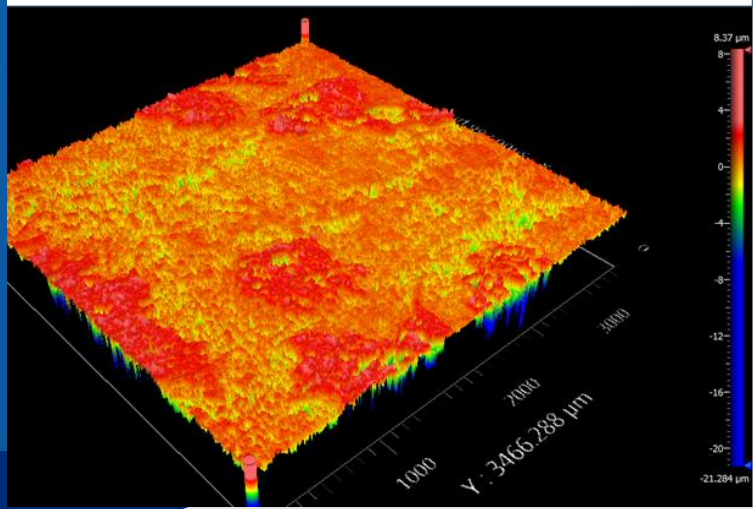
Assessing corrosion response of AM metals

Developing new, corrosion resistant alloys for varied applications. Sensing and measuring corrosion in hard to access areas









PIs: Drs. Sikora & Shaw