Multi Disciplinary Laboratories at the Otto York Center
Bio-Micro-Nanofluidics Lab – Dr. Perez-Castillejos

Micropatterning for eye cell transplants

With Applications in:

• Tissue Engineering
• BioMEMS and Bio-sensors
• Technology creation and development
• Educational Tools in Micro- and Nanotechnologies
• Intercellular communication

Funding from NSF.

Flexible thick metallic electrodes

Opto-fluidic hydrogel device


Our group is working on a range of problems involving complex fluids. Our goal is to develop novel theoretical (numerical) and experimental methods for exploring interesting features of dynamics, from both applied and fundamental points of views. At present our work focuses on:

- Electric field assisted self-assembly of particles
- Manipulation deformable particles: biological cells, drops, bubbles, etc., by externally imposed flows and electric fields
- Dispersion of particles on fluid-liquid interfaces
- Computational fluid dynamics of Newtonian, viscoelastic and electrorheological fluids


Funding from NSF

Selected publications:
P. Singh, et al., *Scientific Reports* 4, 7427; DOI:10.1038/srep07427 (2014).
Nano Carbons and Analytical Chemistry – Dr. Mitra

With Applications in:

• Desalination and Water Treatment
• Fate and Biological Effects of Nano Materials
• Flexible Batteries
• Composites and Coatings
• Catalysts and Adsorbents
• Membranes
• Solar Cells
• Chemical Analysis and Sensors


Particle-Process Engineering & Pharmaceutical Nanotechnology – Dr. Bilgili

With Applications in:

• Nanoparticles & Nanocomposites
• Bioavailability Enhancement & Modified Release of Drugs
• Sterile-filterable Drug Suspensions
• Colloids, Pigments, and Coatings
• Bottom-up & Top-down Particle Formation Processes
• Process Intensification, Modeling, & Optimization

Funding from – NSF, Boehringer-Ingelheim, Catalent Pharma

Surfactant-Free, Redispersible, Nanocomposite Microparticles for Fast Active Agent Delivery

Intensified Wet Milling for Preparation of Sub100 nm Drug Particles and Sterile-filterable/Injectable Nanosuspensions

Multi-Scale Process Models

Novel Nanosuspension Stabilization with Swellable Polymers

Anionic Crosslinked Polymers (CCS, SSG)
Soluble Polymer (HPMC)
Fenofibrate (FNB) Nanoparticles

Enhanced Steric + Kinetic Stabilization

• Research focuses on preparation of new metal-based composite materials
• Materials are studied using x-ray diffraction, electron microscopy, thermal analysis and other techniques
• Ignition and combustion of materials is studied using custom-designed laboratory experiments
• Applications of the materials include energetic formulations (propellants, explosives, pyrotechnics), and materials for in-situ energy sources.

Funding from DOD

Contact: dreizin@njit.edu; 973-596-5751; http://web.njit.edu/~dreyzin/
Stem Cells and Tissue Engineering Lab – Dr. Cho

With Applications in:

- Polymeric Biomaterials
- Scaffold design and fabrication
- Tissue Engineering
- Injectable, multifunctional hydrogels for tissue repairs
- Stem cell bioengineering
- Micropatterning of cells and ECM

Funding from – NIH, Coulter Foundation, BD Biosciences

Derek Yip, Cheul H. Cho, Biochemical and Biophysical Research Communications (2013) 327-332
RESEARCH AREAS

- To develop functional engineered cardiovascular tissues using novel biomaterials and custom-designed bioreactor systems

- To develop novel strategies to enhance the growth of cardiac and vascular tissues in vitro by examining the effects of physical, mechanical, and chemical stimuli on stem cell differentiated cardiac and vascular cells using 3D engineered tissue models

- To investigate tissue engineering approaches to develop microvascular formation in vitro

- To develop vascularized insulin-producing tissues for diabetes treatment
Electric Field Driven Phenomena in Colloids under Microgravity in ISS – Dr. Khusid

Motivation:
Understand underlying physics by removing masking effects of gravity (particle settling, buoyancy driven convection, etc.)

Applications in micro- & nano-fluidics for:
• Aerospace
• Medical diagnostics
• Biotechnology
• Complex materials
• Drug delivery

Elele, Shen, Khusid (NJIT), Pettit (NASA astronaut), Physical Review Letters 114, 054501, 2015

Funding from NASA
Thermo-Chromic Paints and Bio Fuel Cells – Dr. Iqbal

- Thermo- and Chemo-chromic sensing paints and inks
  - Plasma and electrochemical synthesis of high energetic material: Poly-nitrogen
  - PN clusters as oxygen reduction catalyst for fuel cells

- Flexible biofuel cells
  - ARDEC, NSF-planned

- CVD of large scale graphene and boron nanostructures

Funding – US Army ARDEC, SERDP, US DOE

Particle engineering for improved particulate composites

Dr. Rajesh N. Davé
Funding: NSF, Army/Navy, Industrial collaborations

- Research focuses on preparation of **nano and micro particulate composite materials** for pharmaceutical, agrochemical, electronic, catalytic, and specialty chemicals
- Research infrastructure includes advanced particle and materials characterization and processing equipment
- Our graduate students collaborate with **national and international groups** and are part of NSF funded multi-university Center
- Our alumni are working in major industrial companies and in US academia
Facilitating dune building on developed shorelines (NOAA)

- Constraints on aeolian sediment transport across backshores
- Effects of beach management practices on foredune growth

Estuarine beach dynamics (NOAA, NSF, NPS, NGS)

- Sediment transport by waves and swash
- Using nourishment to restore geomorphic and biotic interactions
- Effects of shore protection structures on beach morphology and habitat migration
Nanoelectronics and Energy Conversion Lab (Dr. Ko)

Semiconductor Nanocrystals

Nanocrystal Superlattices

Nanocomposites

Nanoelectronics (field-effect transistors)

Solar cells (light-to-electricity)

Thermoelectrics (heat-to-electricity)

References
- Nanoelectronics: (1) D.-K. Ko et. al., Nano Lett., 2010, 10, 1842-1847
  (2) D.-K. Ko et. al., ACS Nano, 2011, 5, 4810-4817
- Thermoelectrics: (1) D.-K. Ko et. al., Nano Lett., 2011, 11, 2841-2844
  (2) C. Sun, A. Rai, C. Passos, D.-K. Ko (to be published)
New Non-PGM Catalysts for Electrochemical Systems

- With Applications in:
  - Fuel cell technology
  - Metal-air battery
  - Hydrogen Production
  - Ammonia Synthesis
  - Petroleum Processing
  - Hydrogenation/Dehydrogenation Reactions
  - Polymerization Reactions
  - Automobile exhaust gas purifying

- Funding from NJIT
- Support from NJIT, Brookhaven National Lab, Rutgers, CUNY-ASRC


Device Characterization Lab – Dr. Misra

With Applications in:

• Nanoscale CMOS devices
• Semiconductor nanostructures
• Electrical characterization
• NBTI, PBTI, SILC, TZDB, TDDB, interface states and low temperature characterization
• Defect Characterization of Thin-film (CdTe) and Silicon Solar Cells

Funding from-
TEL Technology Center, America, LLC