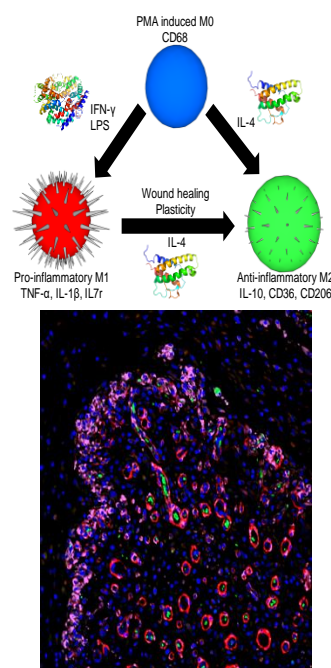
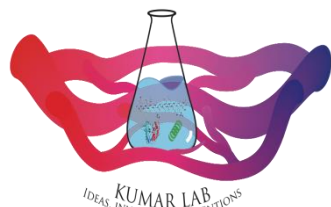


# Multi Disciplinary Laboratories at the Otto York Center



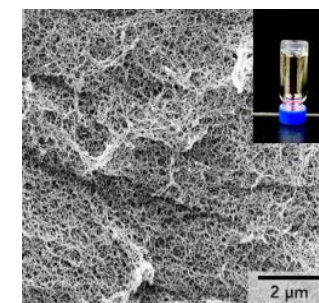
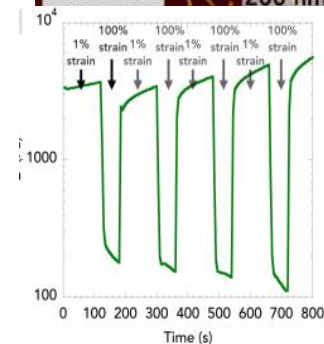
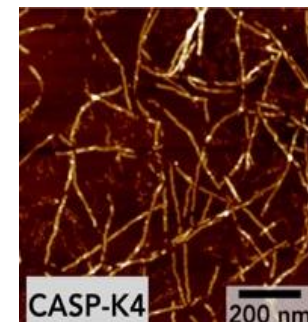
# Biomaterials Drug Discovery and Delivery– Dr. Kumar



## With Novel Materials to address:

- Angiogenic peptides for cardiovascular disease
- Anti-angiogenic peptide for DR and wet-AMD
- Neurogenic scaffolds for TBI recovery
- Drug delivery for opioid addiction management
- Lowering cholesterol with PCSK9 inhibitors
- Scaffolds to regenerate of dental pulp
- Anti-microbials scaffolds for wound healing
- Cell and tissue writing with thixotropic gels

Funding from – NSF, NIH

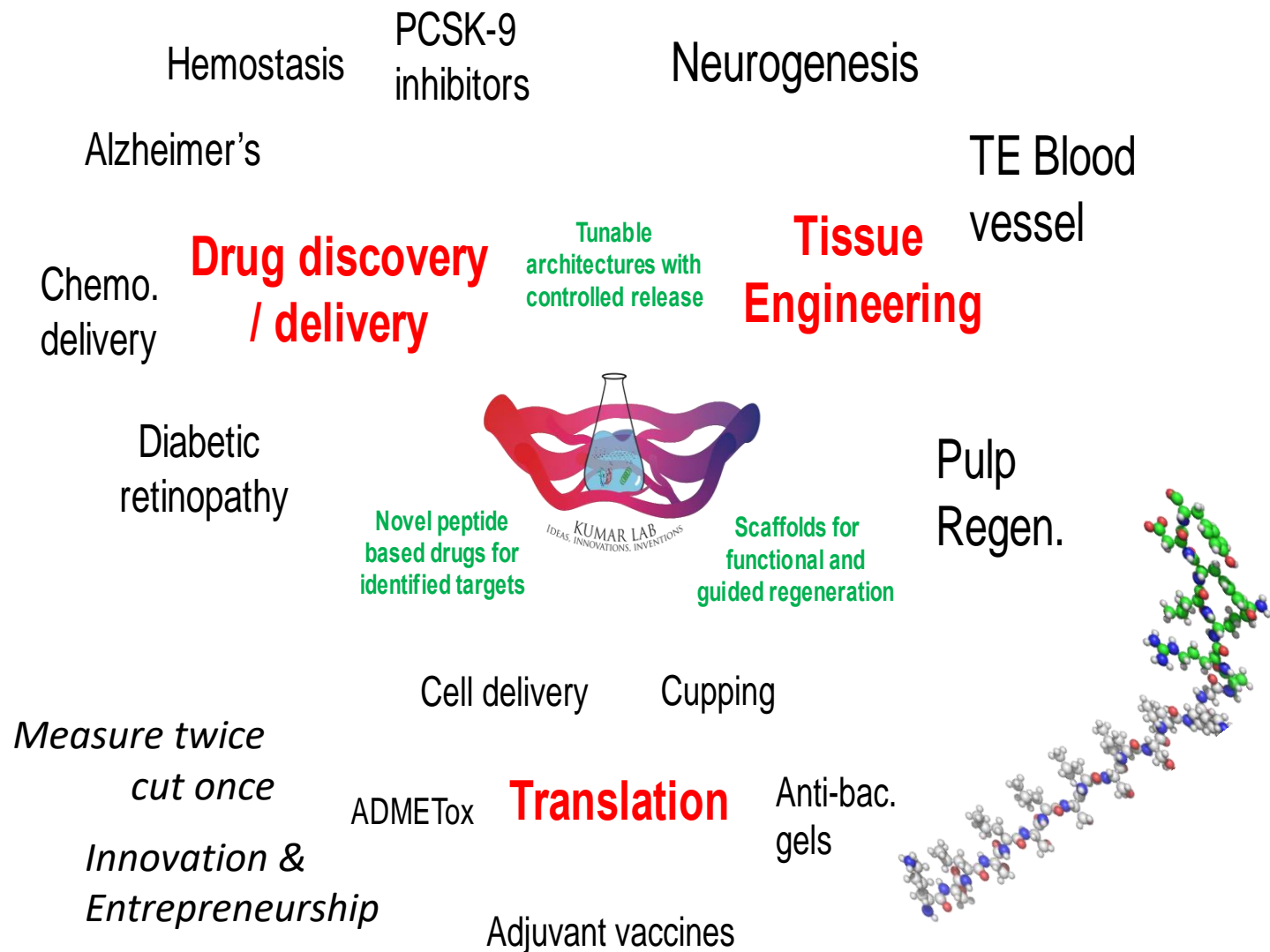


P. Nguyen et al. Self-assembly of an anti-angiogenic nanofibrous peptide hydrogel. **ACS Applied Bio Materials**, 1, 865, 2018

B. Sarkar et al. Angiogenic Self-Assembling Peptide Scaffolds for Functional Tissue Regeneration. **Biomacromolecules**, 19, 3597, 2018

P. Nguyen et al. Self-Assembly of a dentinogenic peptide hydrogel. **ACS Omega**, 3, 5980, 2018

P. Hitscherich, et al. Injectable self-assembling peptide hydrogels for tissue writing and embryonic stem cell culture. **Journal of Biomedical Nanotechnology**, 14, 802, 2018



P. Nguyen et al. Self-assembly of an anti-angiogenic nanofibrous peptide hydrogel. **ACS Applied Bio Materials**, 1, 865, 2018

B. Sarkar et al. Angiogenic Self-Assembling Peptide Scaffolds for Functional Tissue Regeneration. **Biomacromolecules**, 19, 3597, 2018

P. Nguyen et al. Self-Assembly of a dentinogenic peptide hydrogel. **ACS Omega**, 3, 5980, 2018

P. Hitscherich, et al. Injectable self-assembling peptide hydrogels for tissue writing and embryonic stem cell culture. **Journal of Biomedical Nanotechnology**, 14, 802, 2018

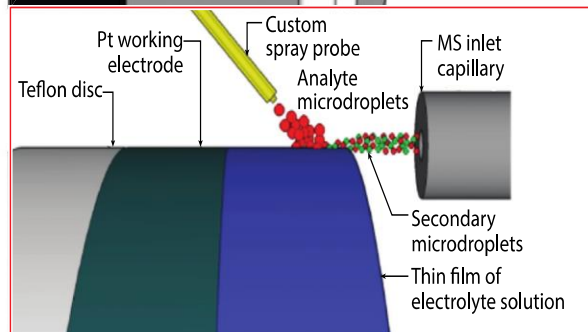
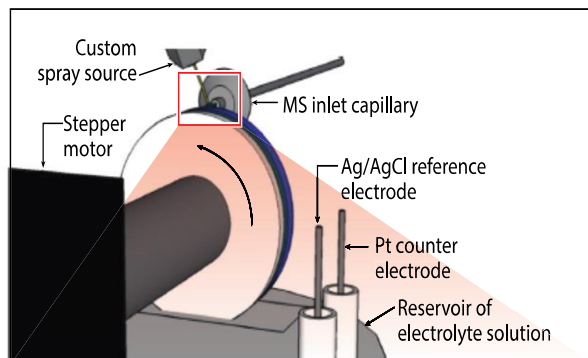
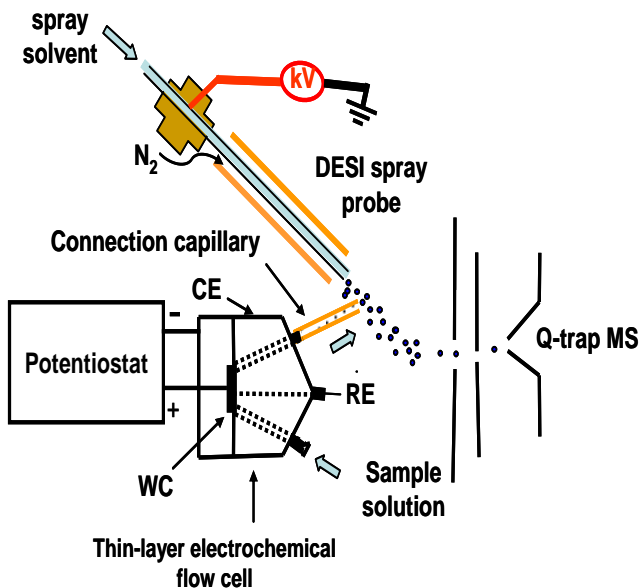
# Combine Mass Spectrometry with Electrochemistry

- Dr. Hao Chen

Electrochemistry can help MS to:

- Elucidate both protein sequence and conformational structure
- Quantify molecules without the use of standards
- Study organometallic and electrochemical reaction mechanism

Fund agencies: NSF, Merck, ASMS



J. Li, H. Dewald, H. Chen, *Anal. Chem.* 2009, 81, 9716

P. Liu, Q. Zheng, H. D. Dewald, R. Zhou, H. Chen, *TrAC*, 2015, 70, 20

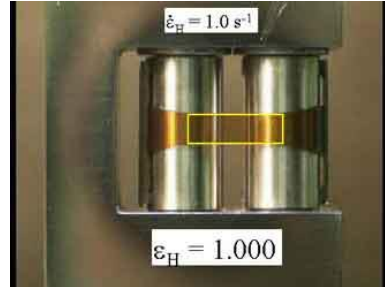
Q. Zheng, H. Chen, *Ann. Rev. Anal. Chem.*, 2016, 9, 411

T. Brown, H. Chen, R. N. Zare, *J. Am. Chem. Soc.* 2015, 137, 7274

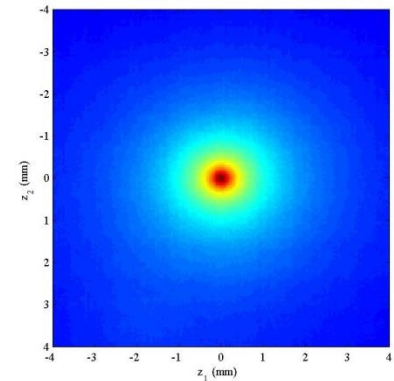
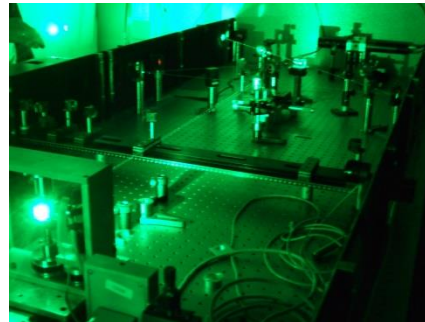
Y. Cai, J. Wang, Y. Zhang, Z. Li, D. Hu, N. Zheng, and H. Chen, *JACS* 2017, 139, 12259

# David Venerus – Research Expertise

- Rheology & processing of complex (polymeric) fluids
  - Rheological characterization methods for shear and elongational flows



- Thermal transport in flowing polymeric materials
  - Novel optical methods to investigate effects of flow on thermal conductivity

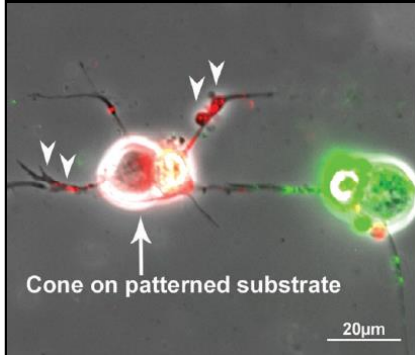


- Interfacial transport phenomena



# Bio-Micro-Nanofluidics Lab – Dr. Perez-Castillejos

## Micropatterning for eye cell transplants



## Flexible thick metallic electrodes

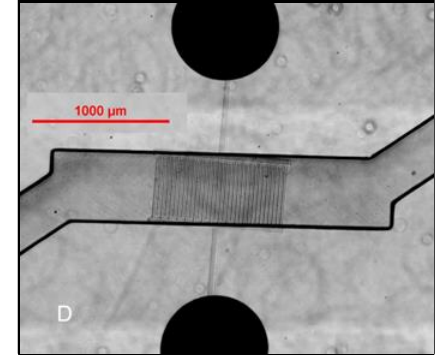


## With Applications in:

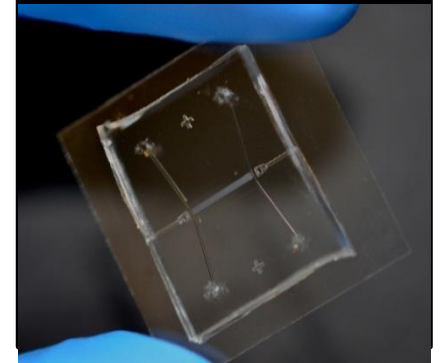
- Tissue Engineering
- BioMEMS and Bio-sensors
- Technology creation and development
- Educational Tools in Micro- and Nanotechnologies
- Inter cellular communication

**Funding from NSF.**

## Micro-electric hybrid devices



## Opto-fluidic hydrogel device



F. Kung, **A.B. Shrirao**, **R. Perez-Castillejos**, and E. Ellen Townes-Anderson. *Positional Effects on Synaptic Connectivity between Photoreceptors*, Integr. Biol. 2015. (published online)

**R. Gomez-Bule**, **R. Broto Cervera**, **C.-M. Hsiao**, **R. Perez-Castillejos**. *Integration of Indium Micromirrors for Biosensing Applications*, Em. Mat. Res. 2013, 2(4):181-185; doi: [10.1680/emr.13.00008](https://doi.org/10.1680/emr.13.00008).

**A.B. Shrirao**, A. Hussain, C.H. Cho, and **R. Perez-Castillejos**. *Adhesive-Tape Soft Lithography for Patterning Mammalian Cells: Application to Wound-Healing Assays*, BioTechniques 2012, doi: [10.2144/000113928](https://doi.org/10.2144/000113928). (Selected 1 of 7 highlights of 2013 by The Scientist).

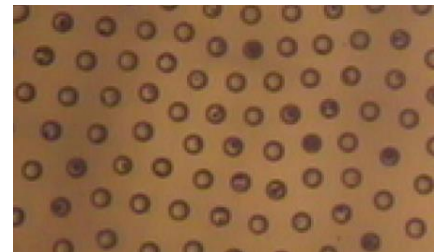
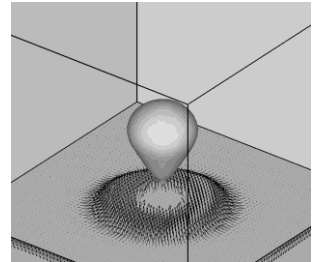
# Micro Flow Control Laboratory – Dr. Singh and Dr. I. Fischer

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

Website: <http://centers.njit.edu/mfcg/research/self-assembly.php>

## Funding from NSF



### Selected publications:

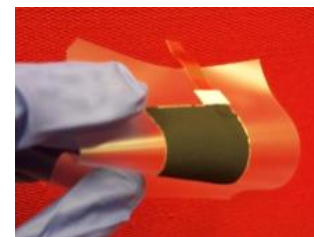
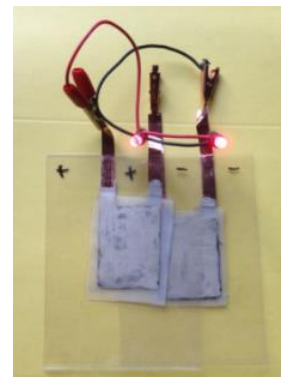
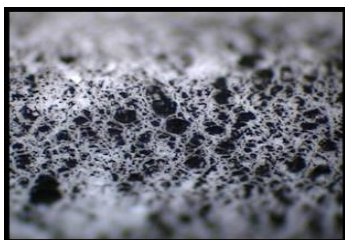
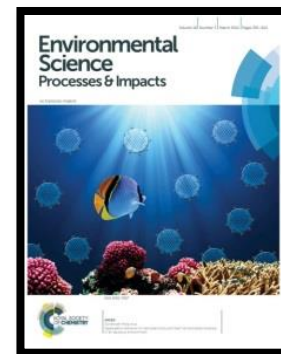
- P. Singh, et al., *Scientific Reports* 4, 7427; DOI:10.1038/srep07427 (2014).  
N. Musunuri, D. Codjoe, B. Dalal, I.S. Fischer and P. Singh, *KONA*, 31, 135-145 (2014).  
P. Singh, M. Hossain, B. Dalal, S.K. Gurupatham and I. Fischer, *MRC*, 45, 54– 57 (2012).  
S.K. Gurupatham, et al., *Particle Technology*, 217, 288–297 (2012).  
P. Singh, D.D. Joseph and N. Aubry, *Soft matter*, 6, 4310–4325 (2010).  
P. Singh, D.D. Joseph, S.K. Gurupatham, B. Dalal and S. Nudurupati, *PNAS*, 106, 19761-19764 (2009).  
C. Verdier, C. Couzon, A. Duperray and P. Singh, *Journal of Mathematical Biology*, 58, 235-259 (2009).

# 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

**Funding from – NIEHS, US DOE, NSF, NIH, US EPA, US Army.**



Lau, Xinbo C., Zhiqian Wang, and Somenath Mitra. *Solar Energy Materials and Solar Cells* 128 (2014): 69-76.  
Chintal Desai, Kun Chen and Somenath Mitra. *Environ. Sci.: Processes Impacts*. 16 (2014): 518-523.  
Zheqiong Wu, Raymond F. Hamilton Jr, Andrij Holian, Somenath Mitra. *Carbon*, 68 (2014): 678-686.  
Bhadra, Madhuleena, Sagar Roy, and Somenath Mitra. *Desalination* 341 (2014): 115-119.  
Zhiqian Wang, Zheqiong Wu and Somenath Mitra. *Advanced Materials*. 26(2014):970-976.

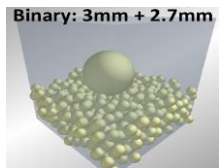


# Particle-Process Engineering & Pharmaceutical Nanotechnology – Dr. Bilgili

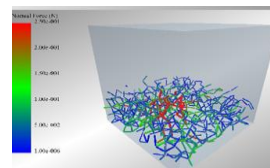
## With Applications in:

- 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

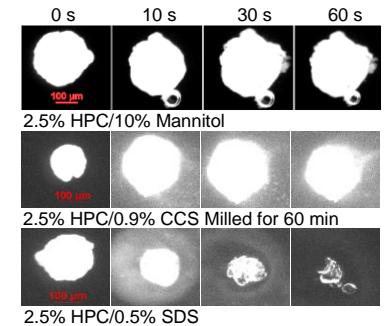
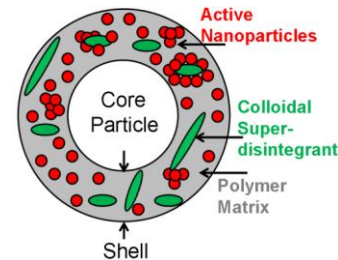
**Funding from – NSF, Boehringer-Ingelheim, Catalent Pharma**



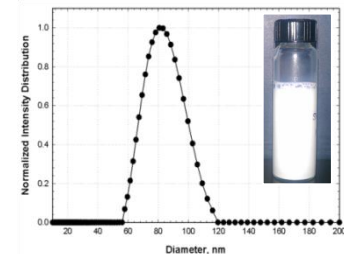
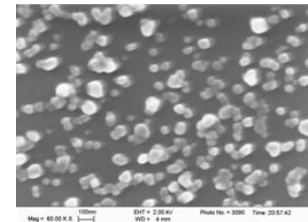
**Multi-Scale Process Models**



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



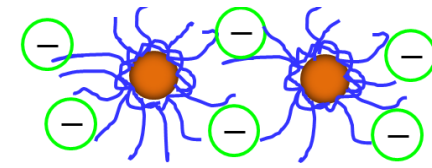
## Intensified Wet Milling for Preparation of Sub100 nm Drug Particles and Sterile-filterable/Injectable Nanosuspensions



## Novel Nanosuspension Stabilization with Swellable Polymers

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

HPMC+CCS/SSG



**Enhanced Steric + Kinetic Stabilization**

Afolawemi Afolabi, Olakemi Akinlabi, and Ecevit Bilgili. *European Journal of Pharmaceutical Sciences* 51 (2014) 75-86.

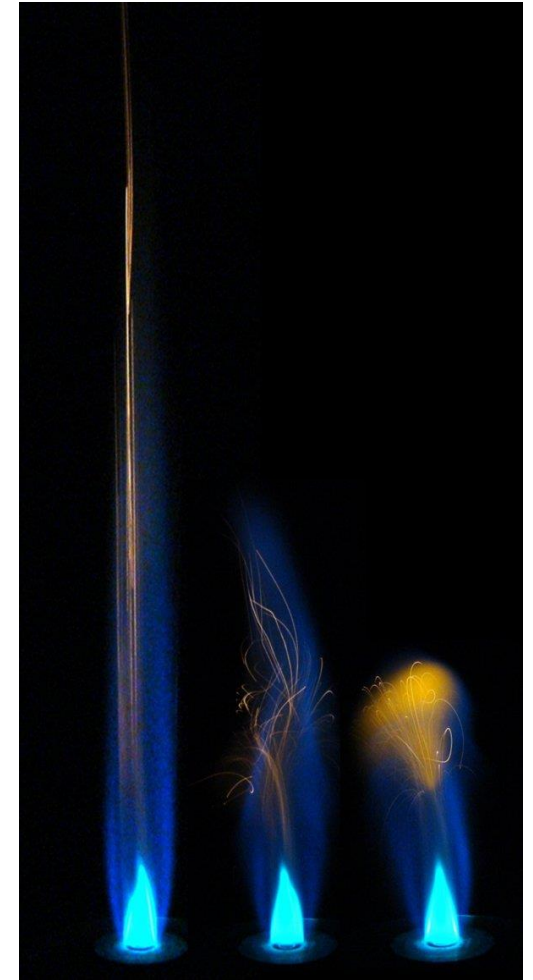
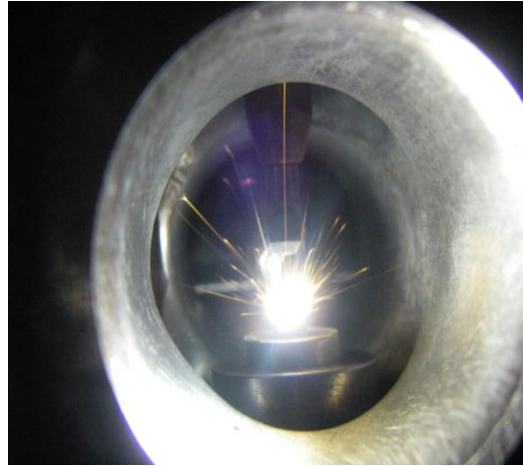
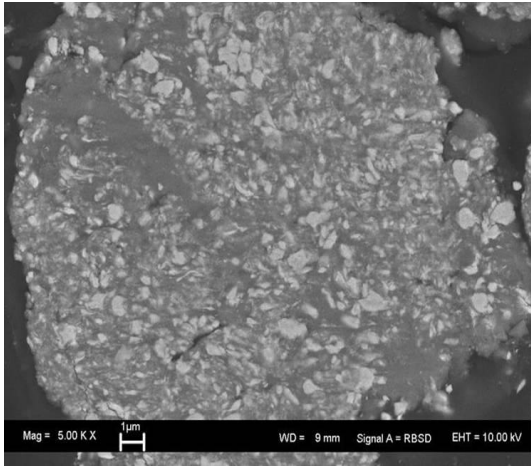
Anagha Bhakay, Mohammad Azad, Emmanuel Vizzotti, Rajesh N. Dave, and Ecevit Bilgili. *Drug Development and Industrial Pharmacy* 40 (2014) 1509-1522.

Maxx Capece, Ecevit Bilgili, and Rajesh Dave. *Chemical Engineering Science* 117 (2014) 318-330.

Ecevit Bilgili (Primary Inventor), Anagha Bhakay, Mohammad Azad, and Rajesh Dave. US Patent Application (2013) US 2013/0295190 A1, Pending.

Ecevit Bilgili and Afolawemi Afolabi. *International Journal of Pharmaceutics* 439 (2012) 193-206.

# Reactive Nanomaterials Lab – Dr. Dreizin



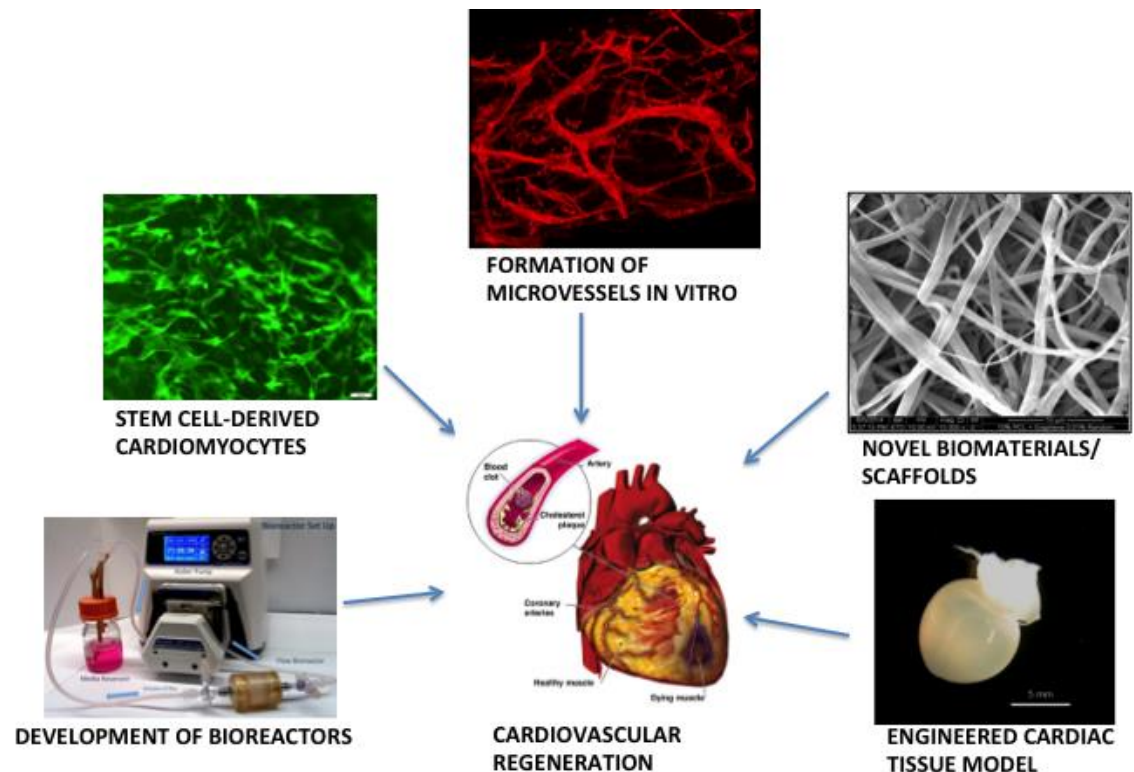
- Research focuses on preparation of **new metal-based composite materials**
- Materials are studied using **x-ray diffraction, electron microscopy, thermal analysis** and other techniques
- **Ignition and combustion** of materials is studied using custom-designed laboratory experiments
- Applications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

**Funding from DOD**

# Cardiovascular Tissue Engineering and Stem Cell Lab – Dr. Alice Lee

## ◆ 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



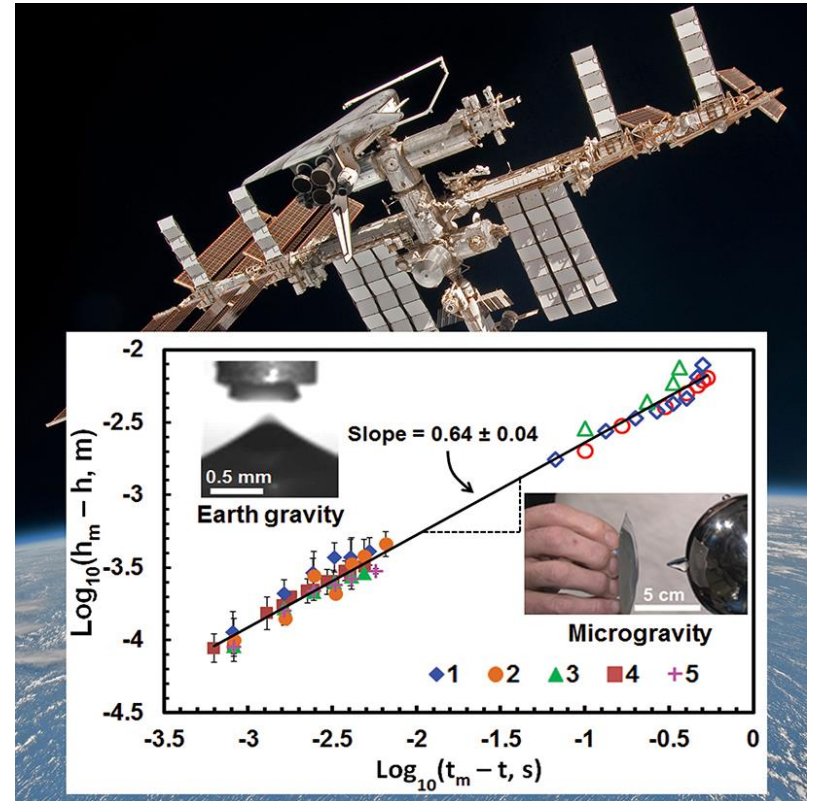
# Electric Field Driven Phenomena in Colloids under Microgravity in ISS – Dr. Khusid

## 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



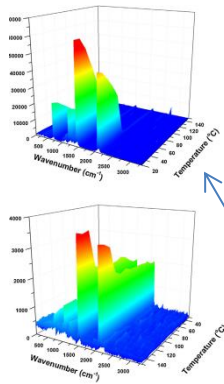
Elele, Shen, Khusid (NJIT), Pettit (NASA astronaut),  
*Physical Review Letters* 114, 054501, 2015

**Funding from NASA**



# Thermo-Chromic Paints and Bio Fuel Cells –Dr. Iqbal

- Thermo- and Chemo-chromic sensing paints and inks

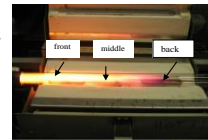


Raman spectra as a function of increasing and decreasing temp



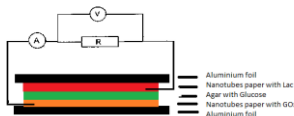
- Plasma and electrochemical synthesis of high energetic material: Poly-nitrogen
- PN clusters as oxygen reduction catalyst for fuel cells

Z. Wu, et al , N<sub>8</sub>- Polynitrogen Stabilized on Multi-Wall Carbon Nanotubes for Oxygen-Reduction Reactions at Ambient Conditions, *Angew. Chem. Int. Ed.* **2014**, 53, 12555; T.G. Manning and Z. Iqbal, Nitriding of Carbon Nanotubes, *US Patent 8,317,978B1* ,**2012**.

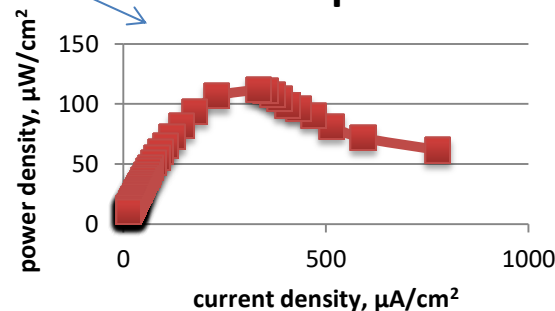


- Flexible biofuel cells

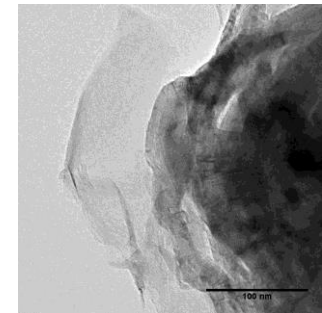
- ARDEC, NSF-planned



current vs. power



- CVD of large scale graphene and boron nanostructures



TEM of large scale CVD graphene

**Funding – US Army ARDEC, SERDP, US DOE**

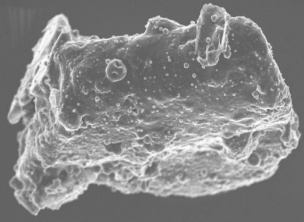


# Particle engineering for improved particulate composites

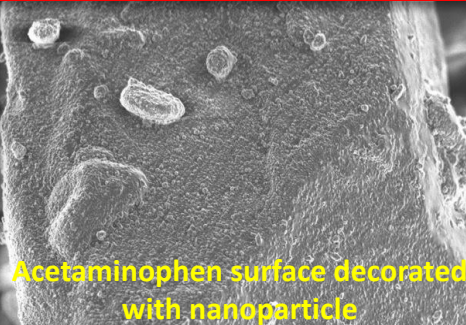
Dr. Rajesh N. Davé

Funding: NSF, Army/Navy, Industrial collaborations

Individually taste-masked  
ibuprofen particle

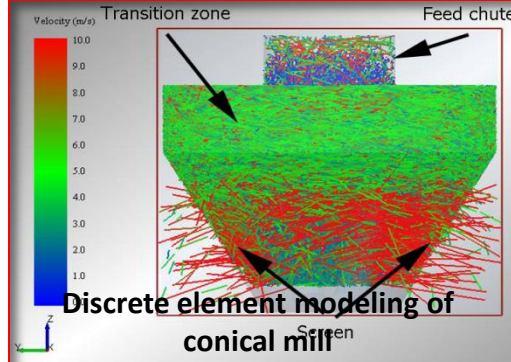


Mag = 5.00 K.X 10µm EHT = 5.00 kV Signal A = InLens Date :26 Mar 2012  
WD = 2 mm Photo No. = 3975 Time :11:02:35



Acetaminophen surface decorated  
with nanoparticle

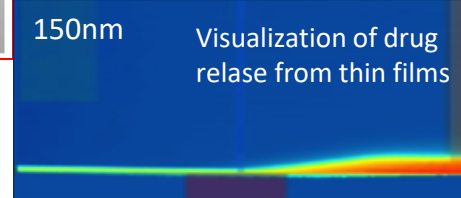
Mag = 10.56 K.X 1µm EHT = 2.00 kV Signal A = InLens Date :10 Oct 2011  
WD = 3 mm Photo No. = 5943 Time :13:04:15



Nano drugparticles  
embedded in quick dissolve  
oral films



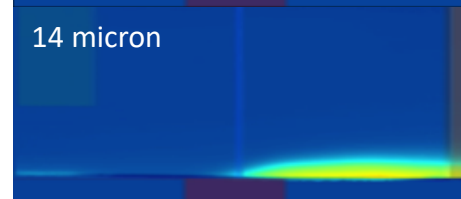
150nm Visualization of drug  
release from thin films



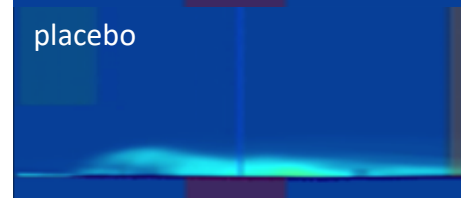
500nm



14 micron



placebo



- 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



**Dr. N.L. Jackson**



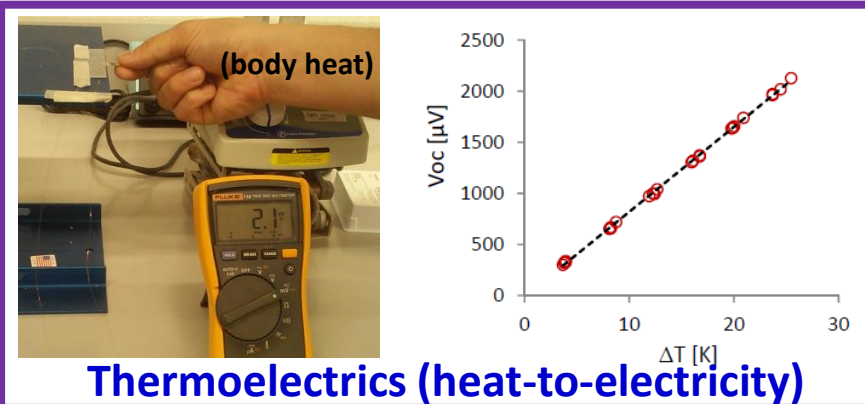
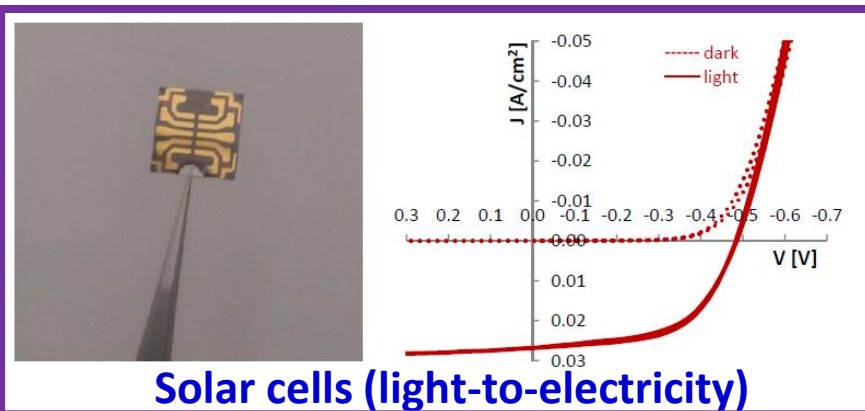
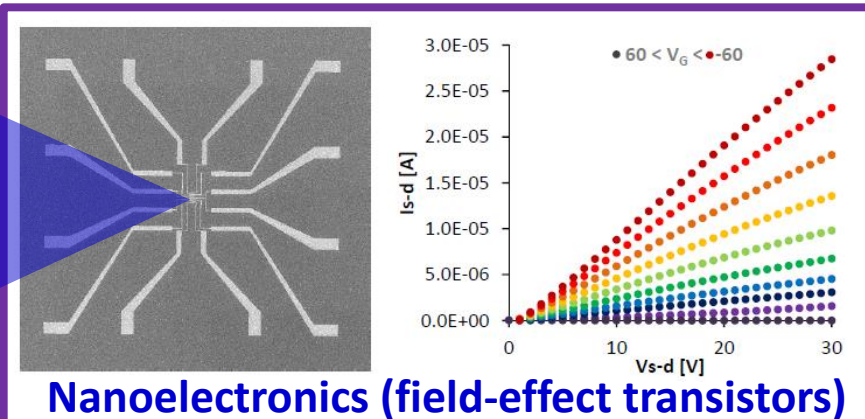
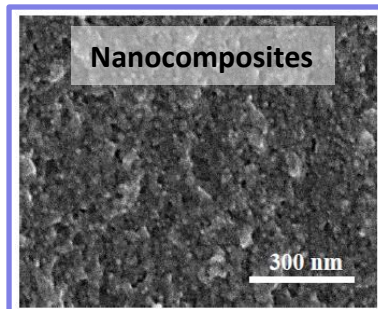
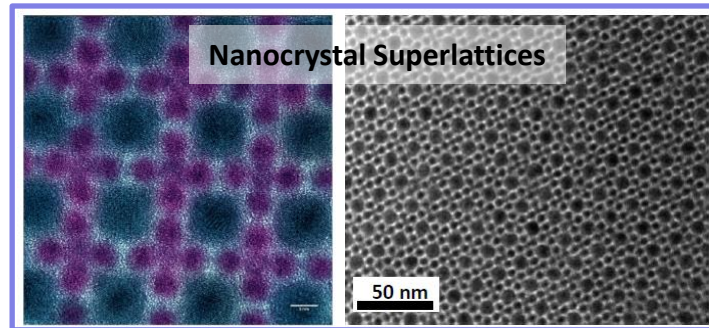
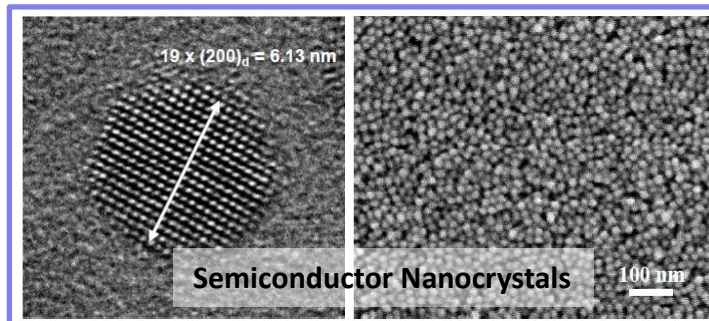
## Estuarine beach dynamics (NOAA, NSF, NPS, NGS)

- 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)



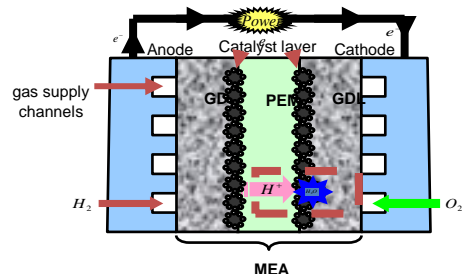
## References

- 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
- Solar cells: D. -K. Ko et. al., *Adv. Mater.*, 2014, 26, 4845-4850
- 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)

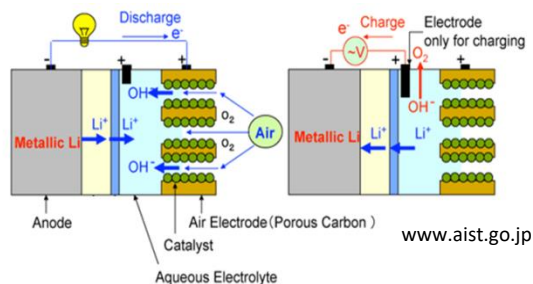
# Advanced Energy Systems and Microdevices Lab

Dr. Eon Soo Lee

## Fuel Cell



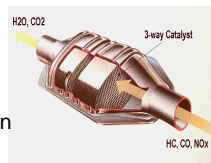
## Metal-Air Battery



## Fuel Cell Car



## Catalytic converter for gas purification



www.aa1car.com

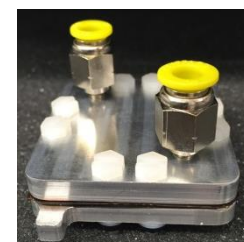
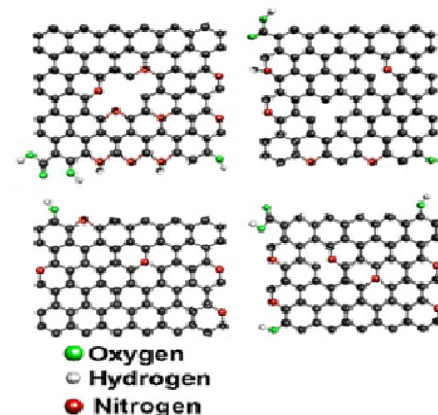
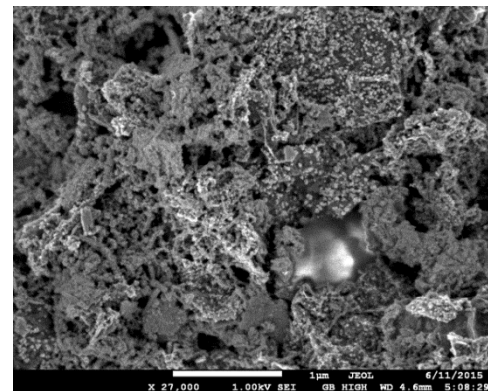
## Petroleum Process



## 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**



Shiqiang Zhuang, Xuan Shi, Eon Soo Lee, POWER & ENERGY 2015-49602 (2015)

Shiqiang Zhuang, Eon Soo Lee, POWER & ENERGY 2015-49909 (2015)

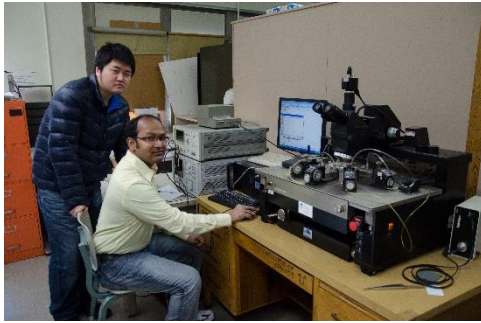
Shiqiang Zhuang, Eon Soo Lee, POWER & ENERGY 2015-49600 (2015)

Patent Application: 15-025 [NJIT] - New Non-Platinum Group Metal (PGM) Catalyst for Fuel Cells and Electrochemical Systems

Patent Application: 15-034 [NJIT] - New Graphene-Based Non-PGM Catalysts with High Porosity Carriers for Electrochemical and Industrial Applications



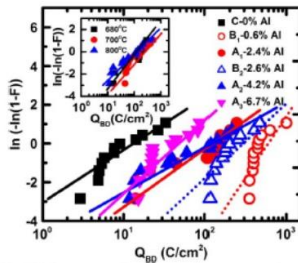
# Device Characterization Lab – Dr. Misra



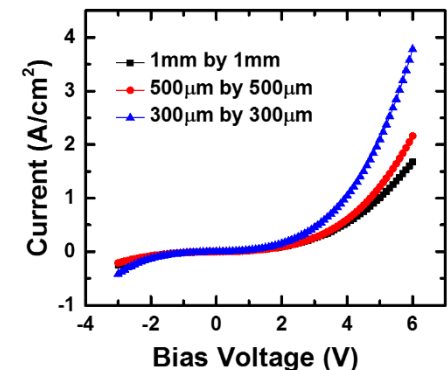
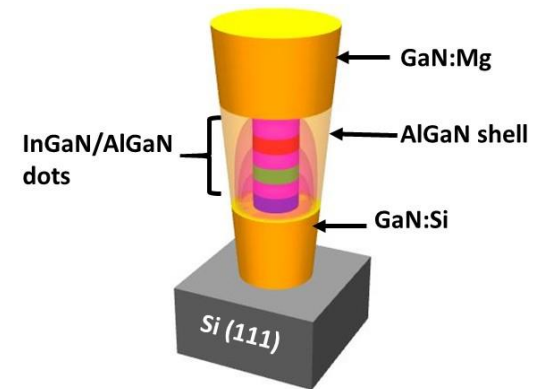
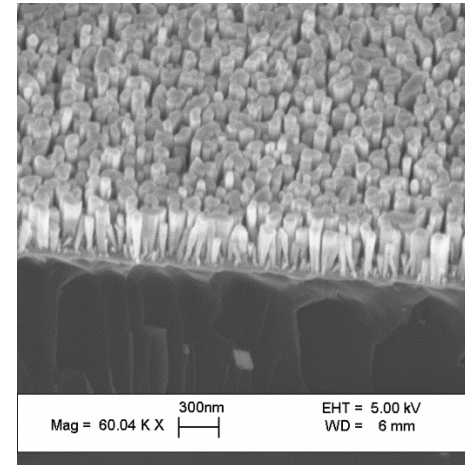
## With Applications in:

- 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

TiN Gate					TiN Gate
10 Cy HfAlO <sub>2</sub>	20 Cy HfAlO <sub>2</sub>	30 Cy HfAlO <sub>2</sub>	20 Cy HfO <sub>2</sub>	10 Cy HfO <sub>2</sub>	40 Cy HfO <sub>2</sub>
30 Cy HfO <sub>2</sub>	20 Cy HfO <sub>2</sub>	10 Cy HfO <sub>2</sub>	10 Cy HfAlO <sub>2</sub>	20 Cy HfAlO <sub>2</sub>	10 Cy HfO <sub>2</sub>
SiO <sub>2</sub> (IL)					SiO <sub>2</sub> (IL)
Substrate (p-Si)					Substrate (p-Si)
A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	B <sub>1</sub>	B <sub>2</sub>	C



**Funding from-**  
**TEL Technology Center, America, LLC**



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 M. N. Bhuyian and D. Misra, *IEEE TDMR*, **15**(2), 229 (2015).  
 M. N. Bhuyian, S. Poddar, and D. Misra, *Appl. Phys. Lett.* **106**, 193508 (2015).  
 Y. M. Ding and D. Misra, *J. Vac. Sci. Technol. B* **33** (2), 021203 (2015).