

**Annual PREM-PI Meeting, Sept 14<sup>th</sup>, 2012**

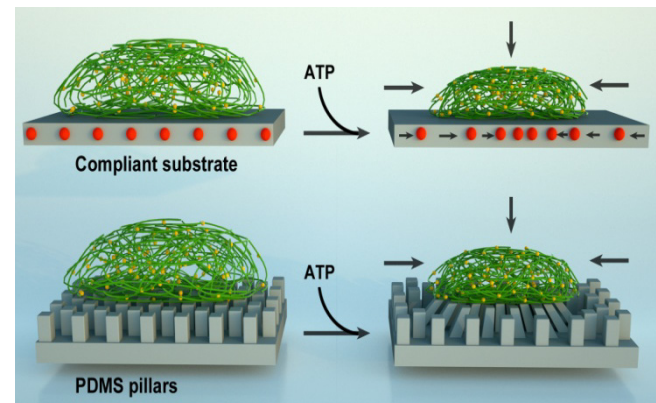
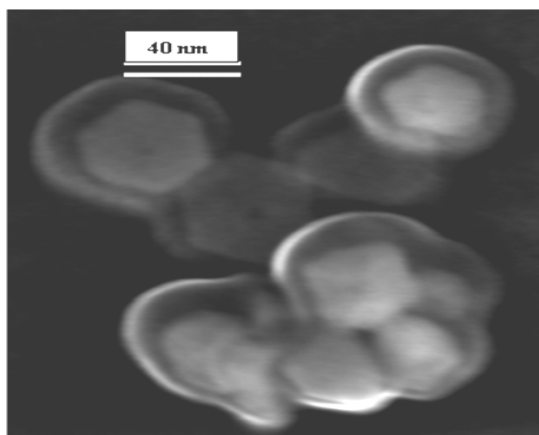
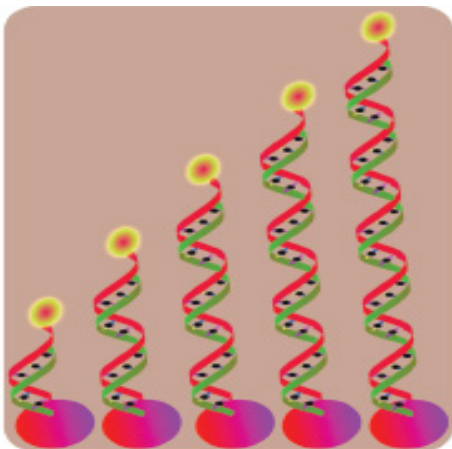
# **PREM-to-PREM Interactions**

**Paresh Chandra Ray and other  
PREM Members**

**Department of Chemistry, Jackson State University, Jackson, MS, USA**



# JSU-UCSB Partnership for Research and Education in Material Science



Funded  
by the  
National  
Science  
Foundation





# PREM Faculty MEMBERS

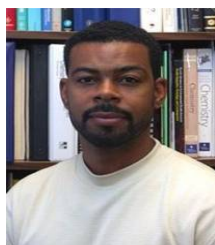


**Program Director (PD)**

**Ray**



**Jerzy**



**Ashton**



**Yu**



**Hawker**



**Pak**



**Ram**



**Gao**



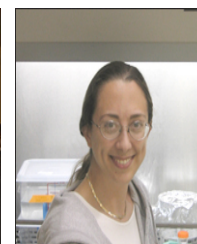
**Hill**



**Quinton**



**Valentine**



**Fygenson**



**Jaeger**

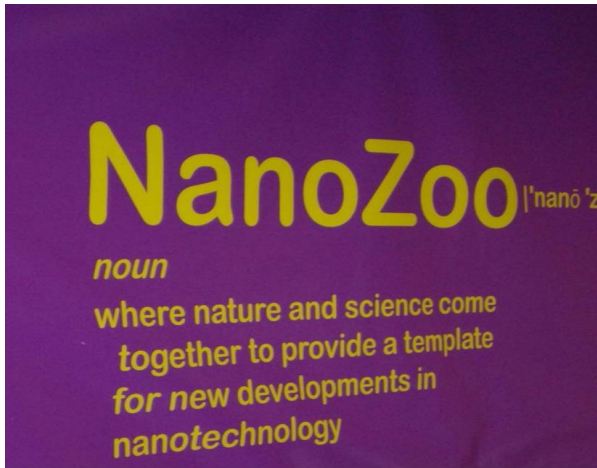


**Nguyen**

**JSU Team Members**

**UCSB Team Members**

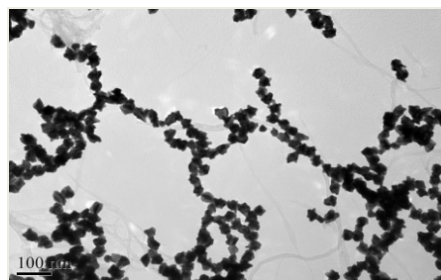
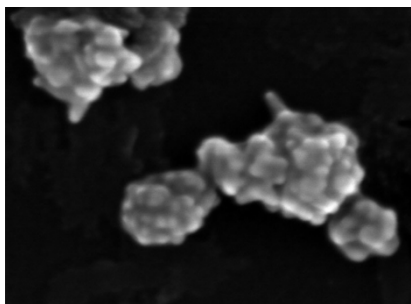
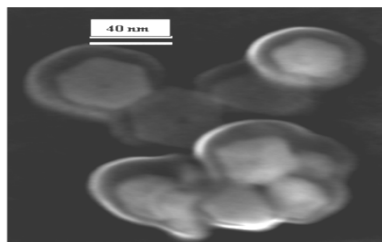
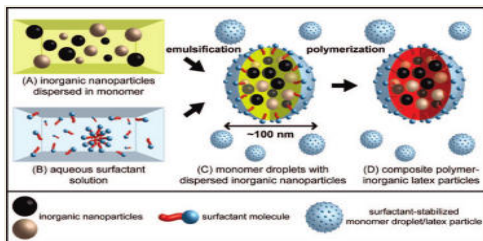
**Our mission:** To foster collaborative, interdisciplinary research and education in the areas of Multifunctional Nanostructured material and Mechanically-Active Hybrid Biomolecular Gels that will address the future needs of society and will increase the participation of minorities in material science research and education.



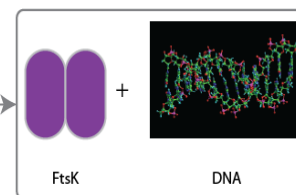
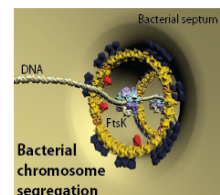
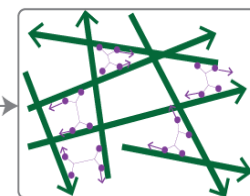
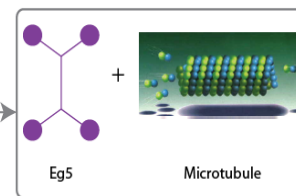
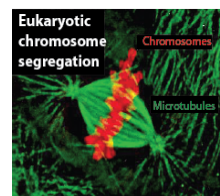
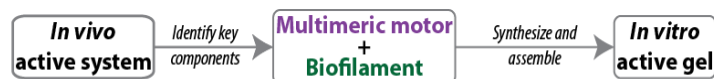
# Goal and Objectives



## Education of next generation material scientists

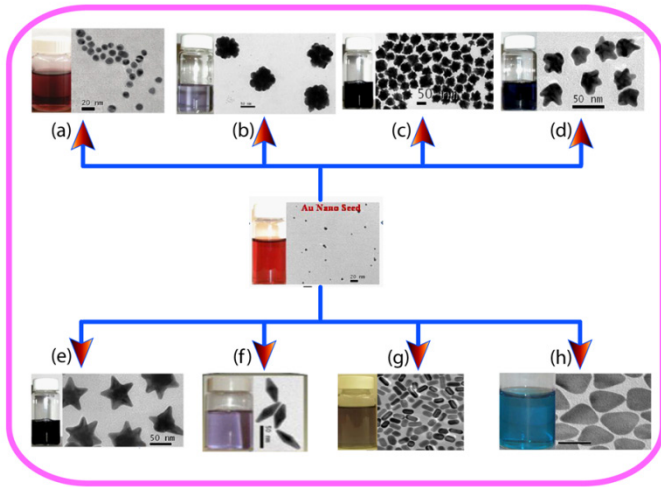


**Multifunctional Nanostructured material**

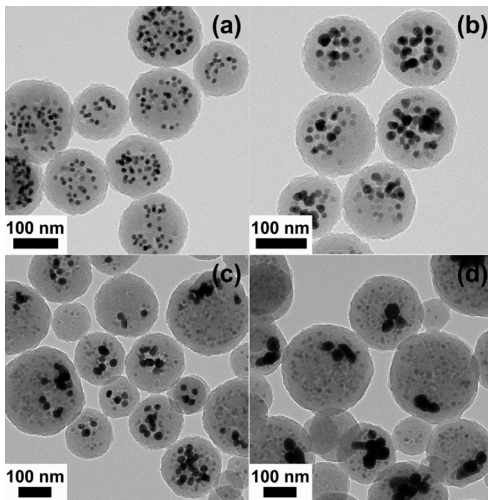


**Mechanically-Active Hybrid Biomolecular Gels**

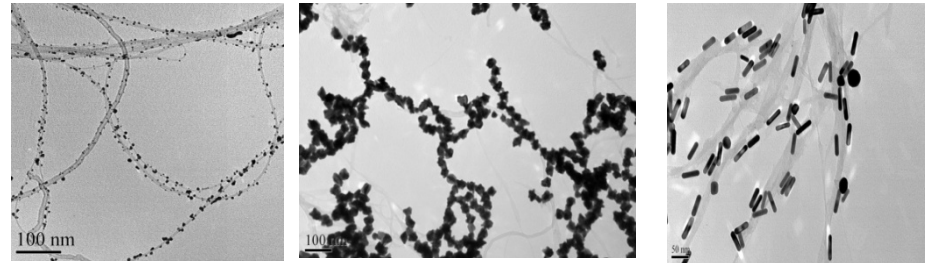
# Developed Multifunctional Material



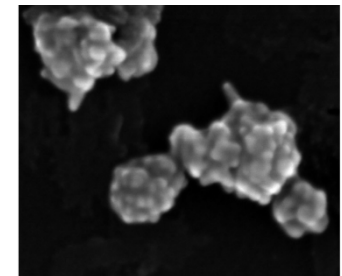
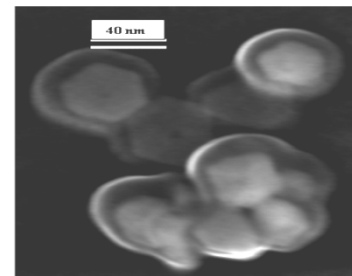
**Gold Nanomaterial**



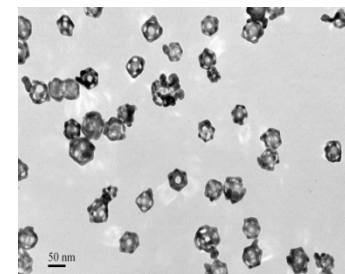
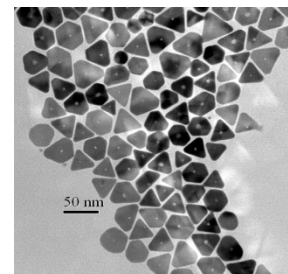
**Hybrid gold-polymer composite**



**CNT/gold hybrid Nanomaterial**



**Plasmonic core-Magnetic shell**

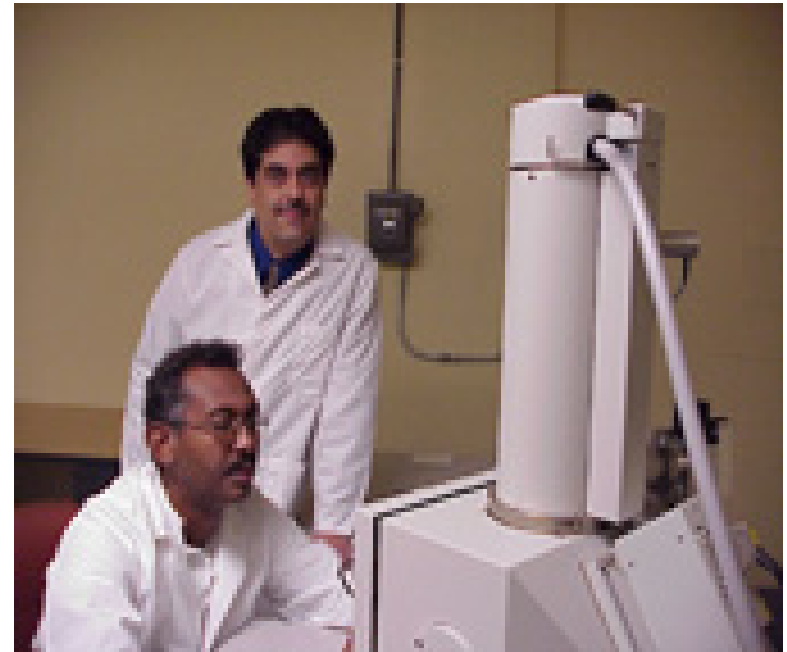


**Hollow Multifunctional Nanomaterial**

# JSU Facilities on Material Characterization



**JEOL-1011 Transmission  
Electron Microscope System**



**Quanta 200 ESEM  
Environmental Scanning  
Electron Microscope**

# What we are lacking?

**High Resolution (HR) SEM, TEM and EDX facilities**



# Our PREM Member First Visit

University of Texas  
at San Antonio

Department of Physics & Astronomy

**Dr. Paresh Ray**

*Department of Chemistry, Jackson State University*

**Friday September 24, 2010**  
**Time: 3:00 p.m. - 4:00 p.m.**  
**BB 3.03.02**

# Kleberg Advanced Microscopy Center

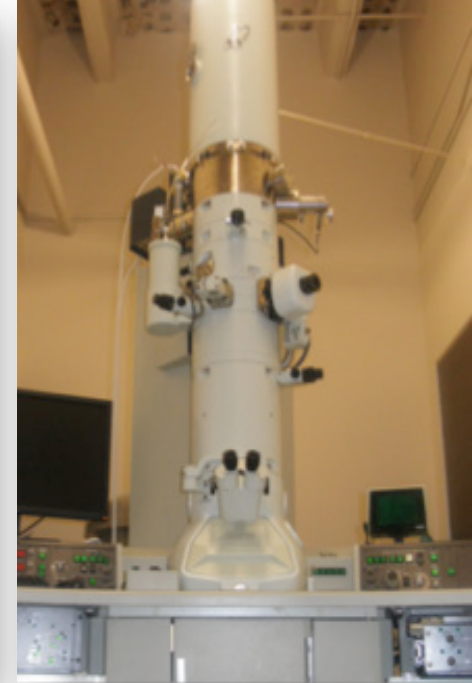
**JEOL ARM 200F**



**Hitachi S-5500**



**JEOL 2010F**

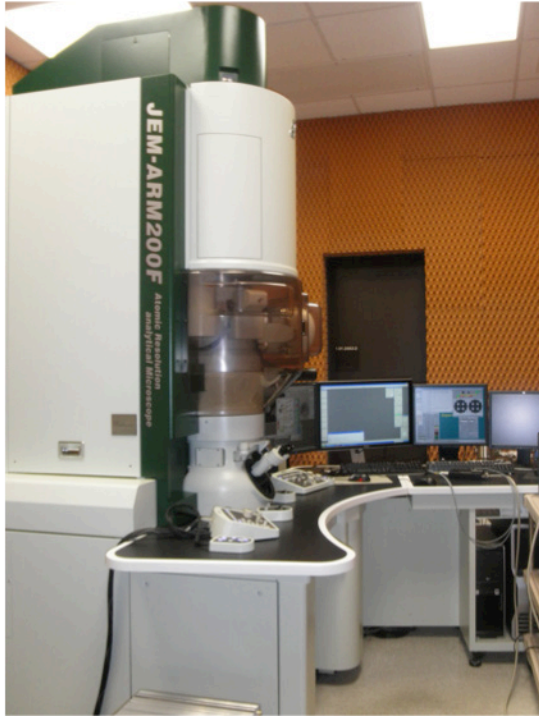


**HOLDERS:**  Nanomechanical and Tomography

Plasma cleaner



# Atomic Resolution Microscope JEOL ARM200F



Atomic Resolution Microscope TEM-STEM JEOL-ARM200F with a corrected probe. It is equipped with a CEOS Hexapole Cs corrector and that is capable to reach a resolution of 0.8 Å in the STEM mode and 1.2 Å in the TEM mode (no correction) at 200 kV. In addition, spatially resolved elemental analysis by X-ray emission spectroscopy and localized electronic structure measurements by electron energy-loss spectroscopy are included. The flexible condenser system permits convergent beam diffraction and nanodiffraction in TEM and STEM modes. In addition, the microscope has been configured to work at low voltages, 120 and 80 kV with the aberration probe corrector and it is capable to reach sub Angstrom resolution.



In situ TEM experiments can be carried out:

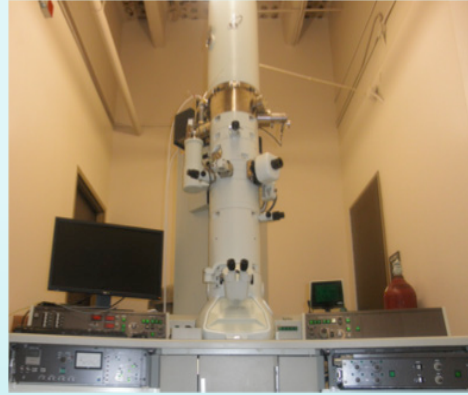
- 1) AFM nanomechanical holder with a piezo sensitivity of 1 nm and a maximum force of 6000 nN
- 2) Tomography holder, which allows a maximum tilting of  $\pm 70$  degrees, 3D reconstruction and visualization software package integrated to the JEOL-ARM200F microscope.



# Facilities: Electron Microscopy



**Hitachi S-5500** Scanning electron microscope equipped with STEM detectors in bright field and dark field modes, which register the electrons simultaneously. The SEM/TEM microscope has a field-emission gun with a 0.4 nm of spatial resolution operated at 30 kV. Spatially resolved chemical analysis by X-ray emission spectroscopy is equipped with a solid-state Bruker, elemental line scanning, 2D mapping are available. Qualitative chemical information can be obtained from the topography of a material by using an automated YAG backscattered electron detector.

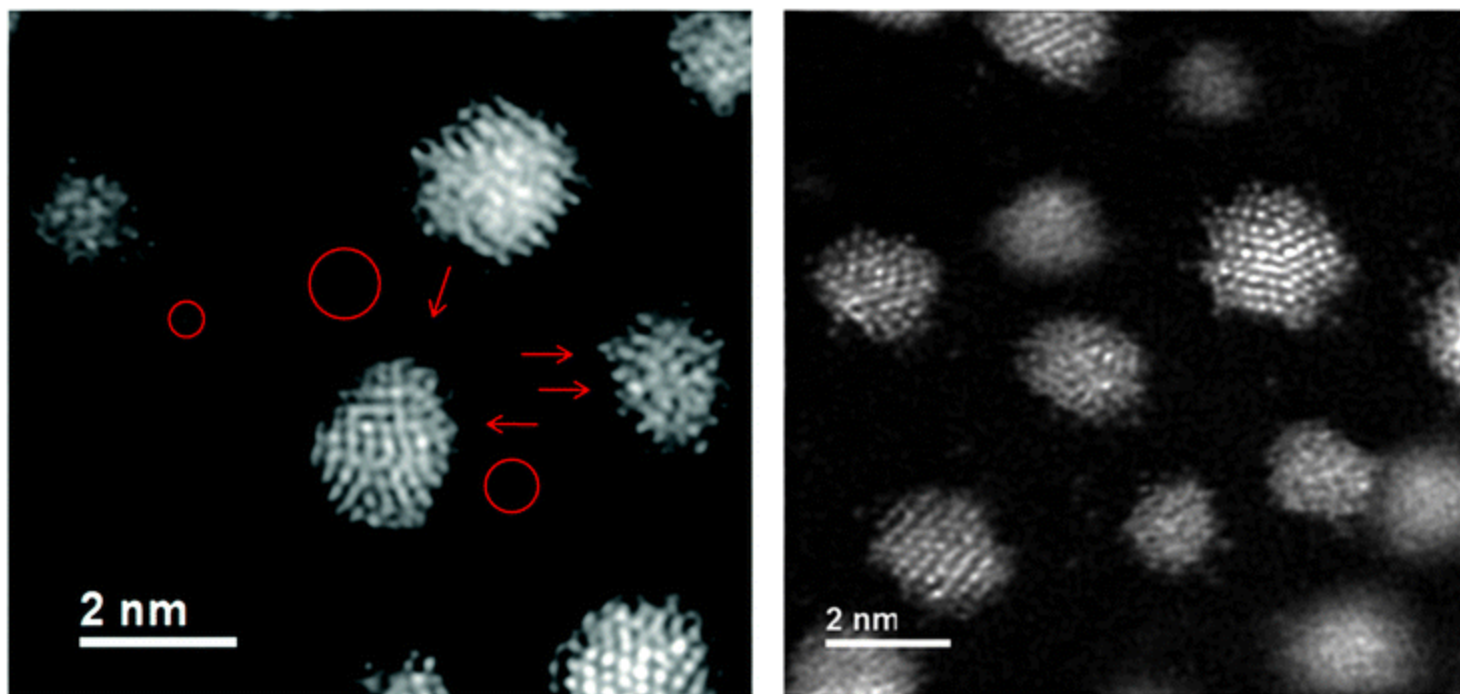


Transmission electron microscope JEOL2010F with a high-resolution pole piece 1.9 Å. Diffraction contrast (BF and DF) and phase contrast (HRTEM) can be used. Selected area electron diffraction and convergent electron beam diffraction are available.



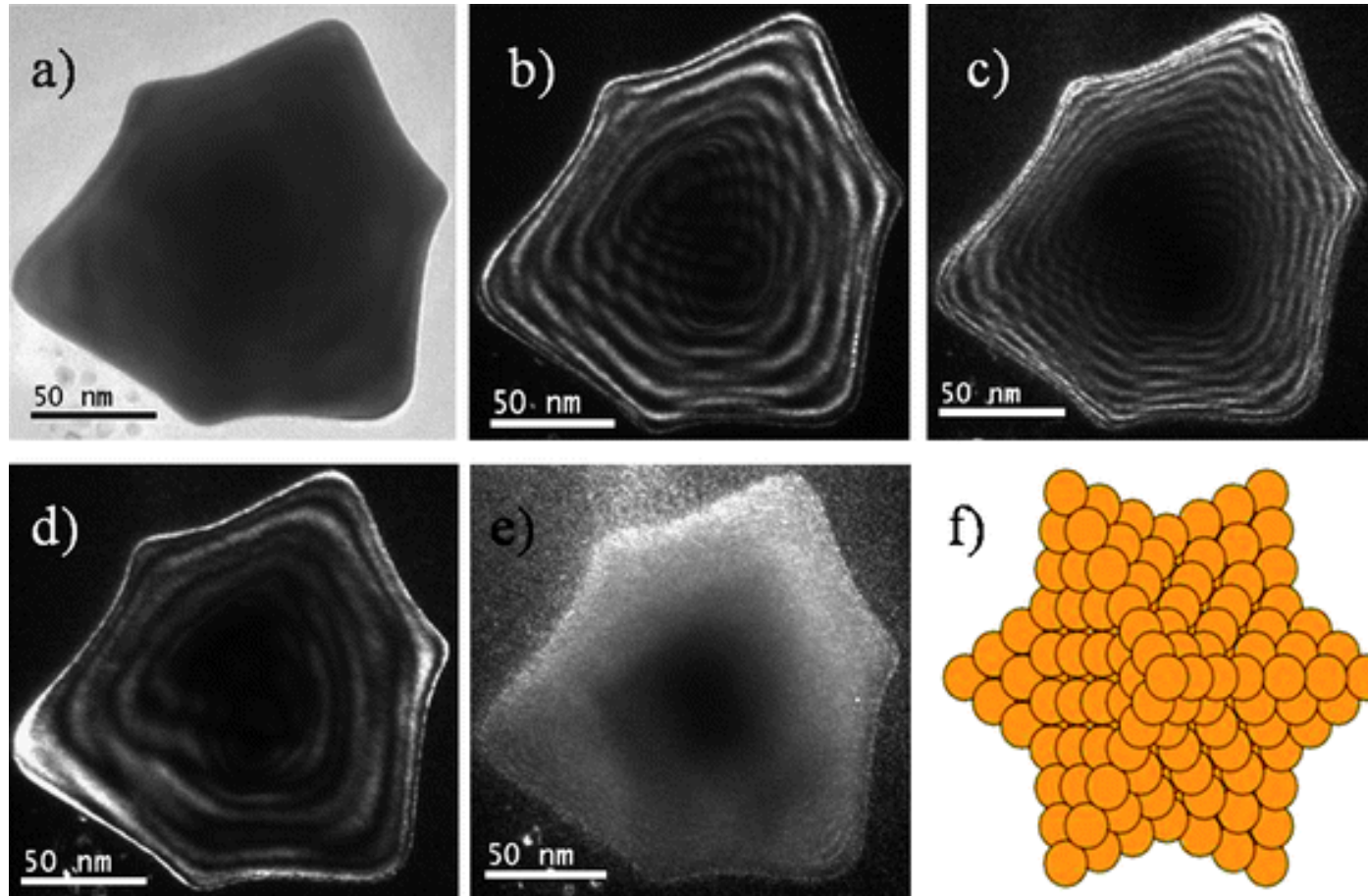
JEOL-1230 Transmission electron microscope operated at 80 kV. Electron diffraction and diffraction contrast imaging are available.

# On the atomic structure of thiol-protected gold nanoparticles

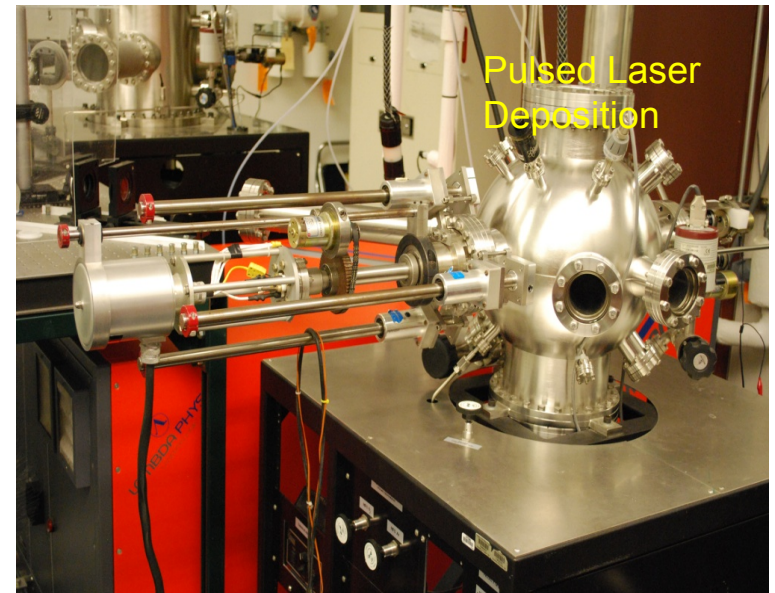


Miguel Jose-Yacaman et. al. , **Phys. Chem. Chem. Phys.**, 2010,12,  
11785-11790

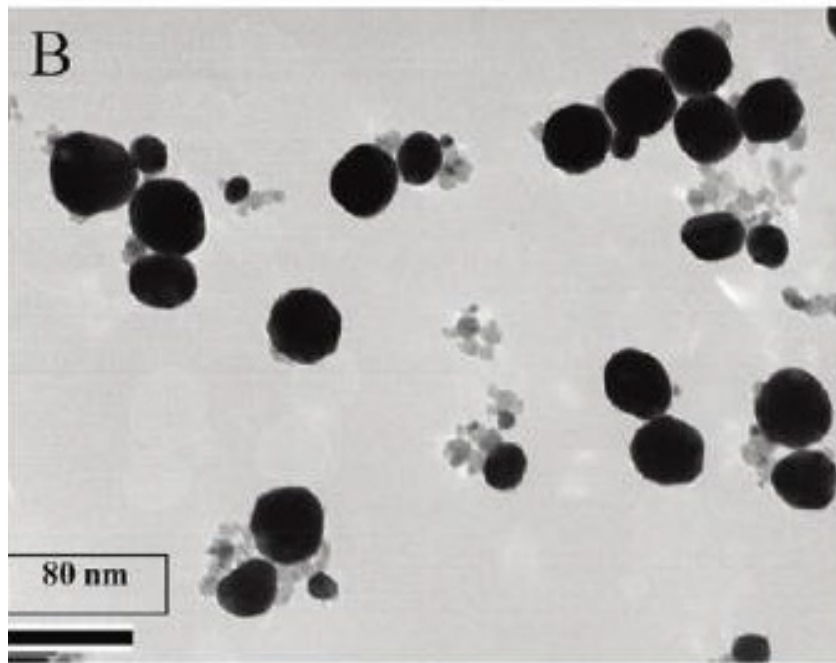
# Single crystal Au/Ag nanoparticles



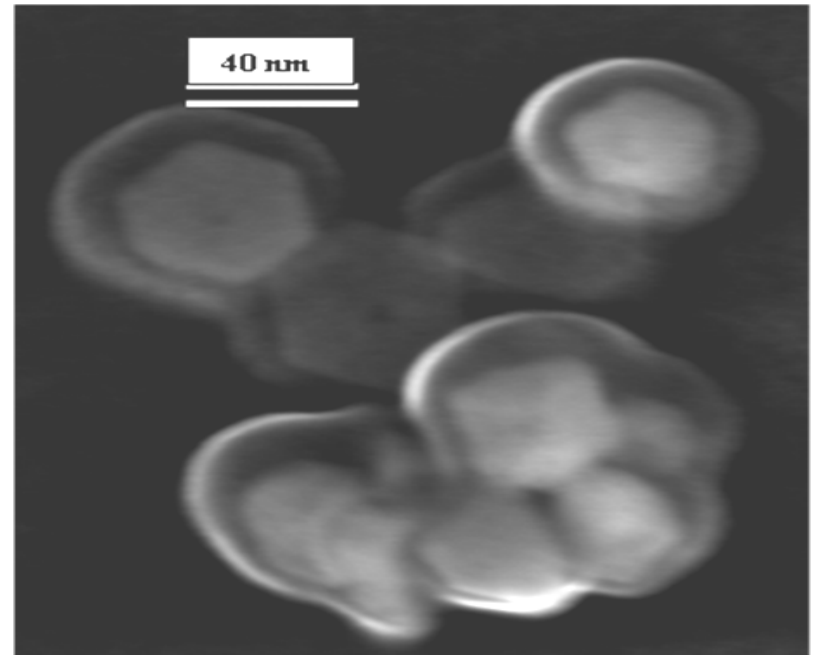
# Research Infrastructure



# Characterization Using HR TEM & SEM



**JSU TEM**

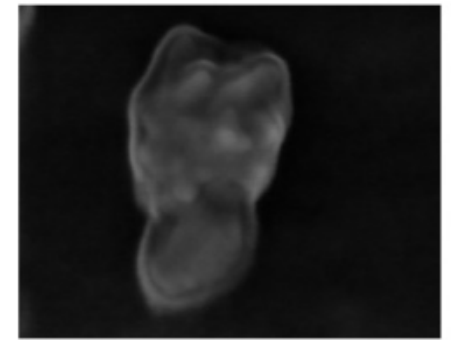
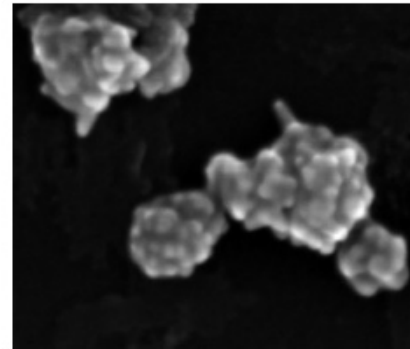
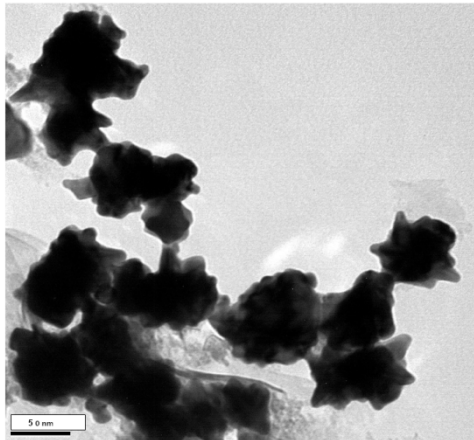


**Hitachi S-5500**

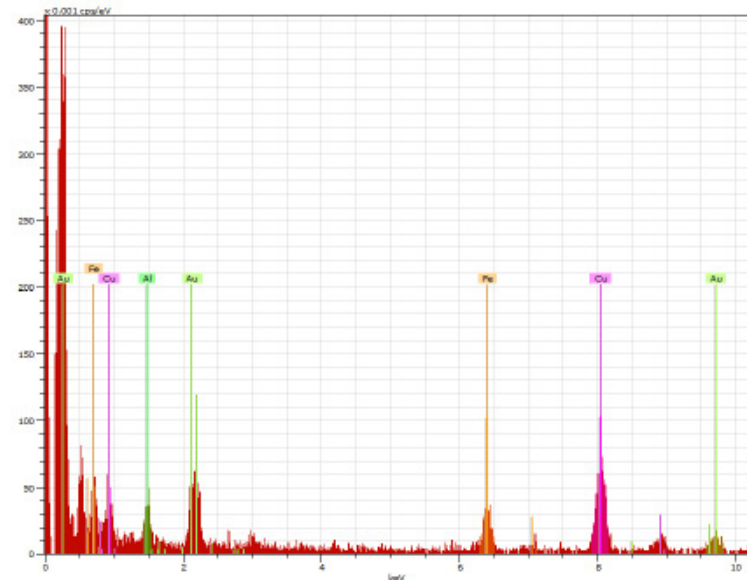
**Iron Oxide Magnetic Core- Gold Plasmonic Shell Nanoparticles**



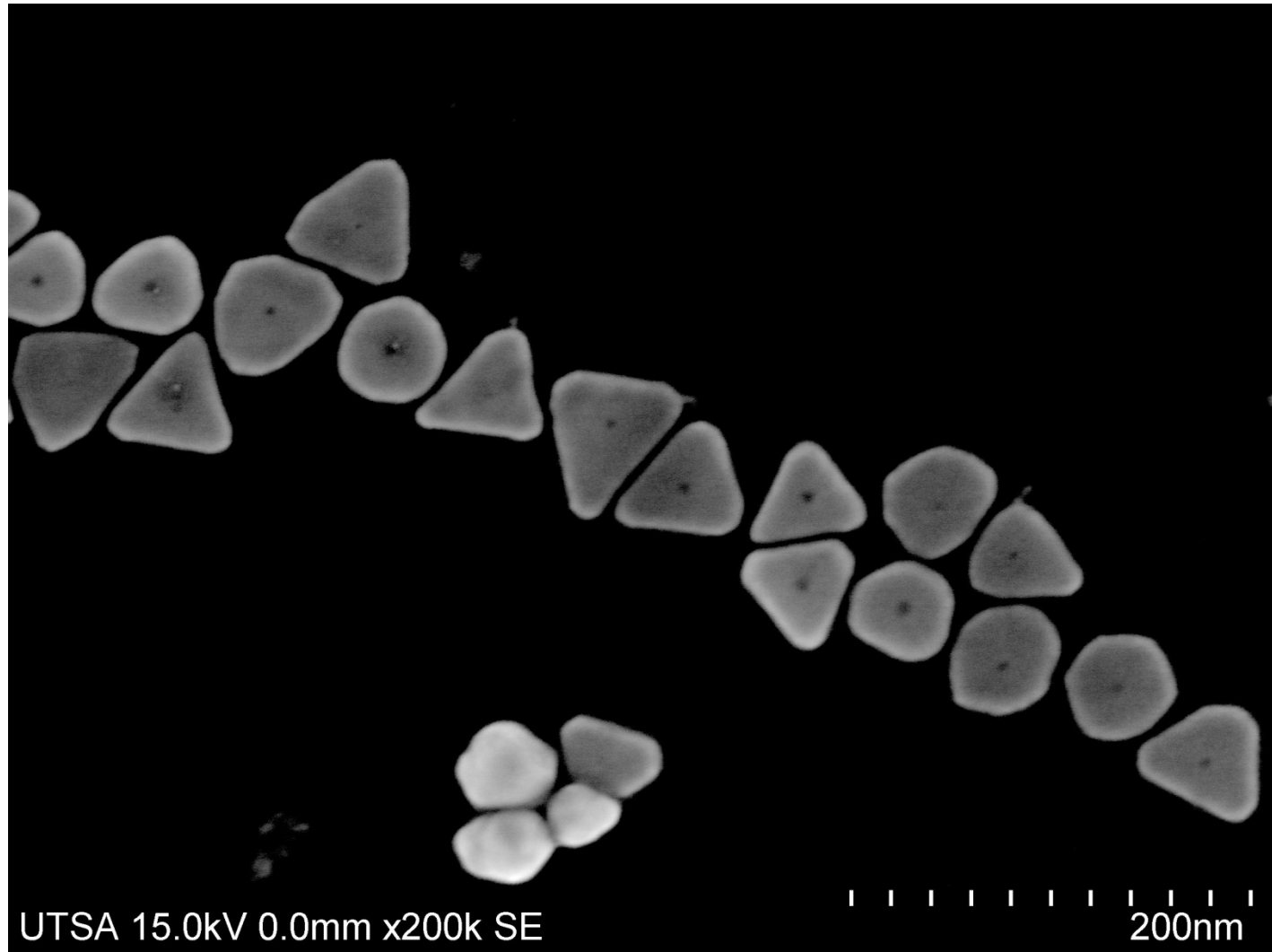
# Characterization Using HR TEM & SEM



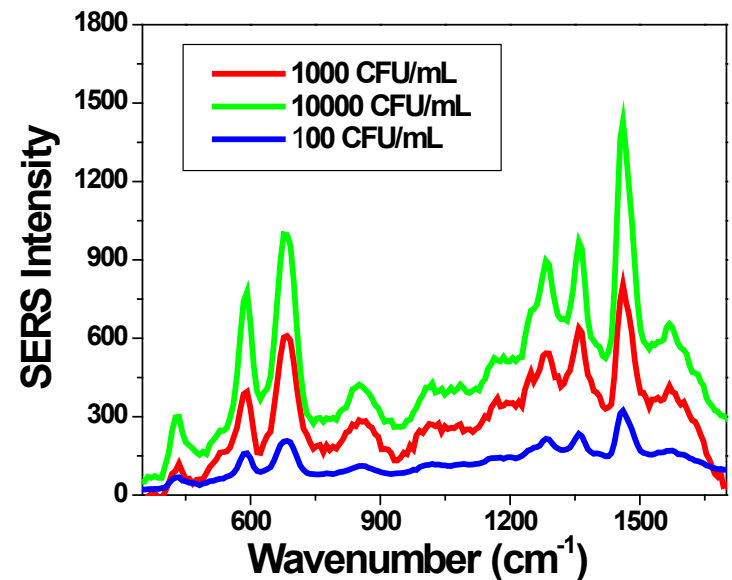
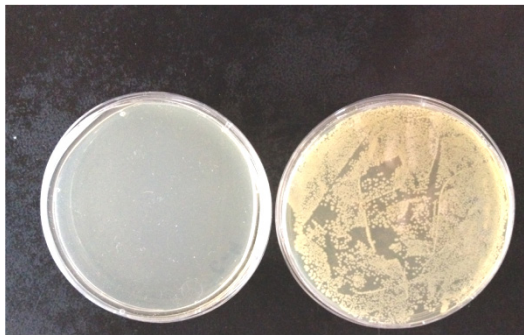
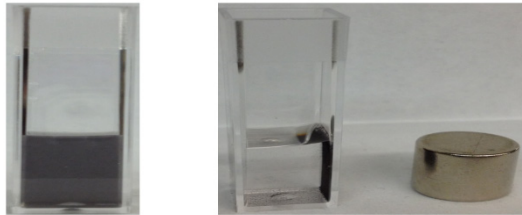
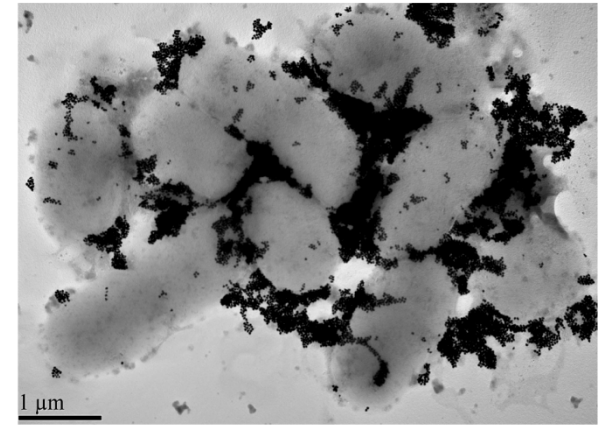
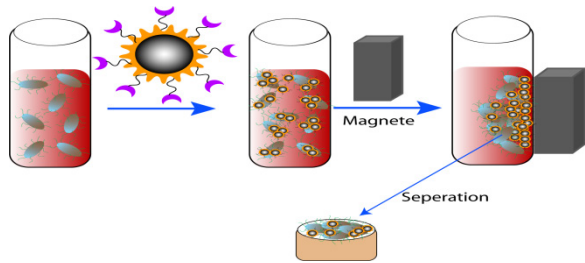
**Iron Magnetic Core- Gold  
Plasmonic Shell popcorn shape  
Nanoparticles**



# Hollow Nanoprism Self Assembly

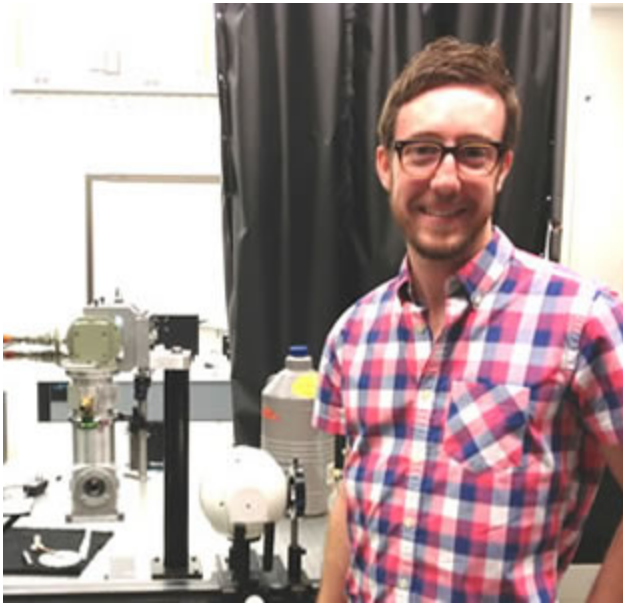


# Separation & Enrichment, Label-Free SERS Imaging and Photothermal Destruction of MRSA



Collaborative Paper Submitted to *Chem. A. Eur. J.*

# **JSU Bio Imaging Facility Helps UTSA PREM Members to Improve Their Biomaterial Research**

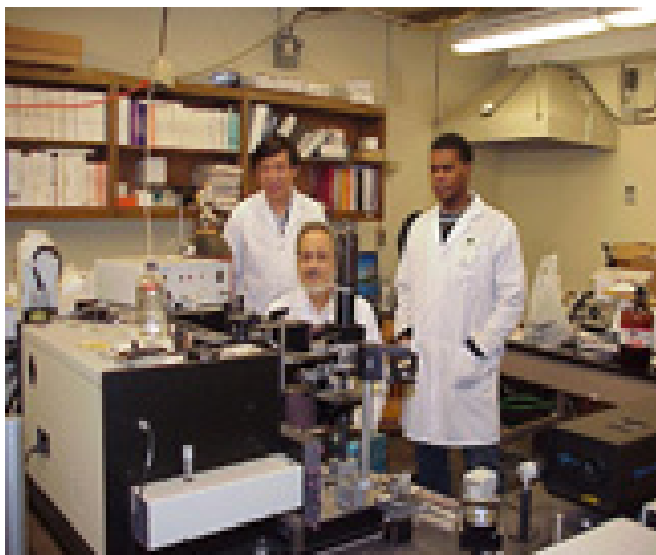


**Brian Yust**

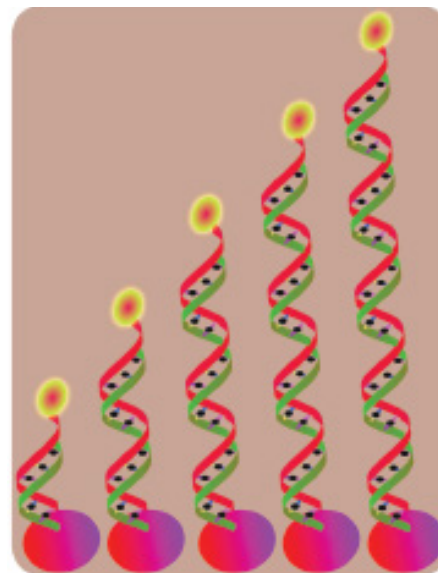
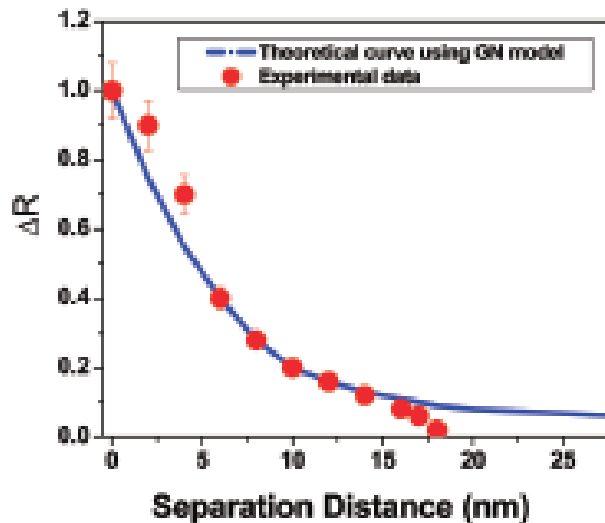


**Jianhui Yang**

# JSU Facilities on Bio-Imaging

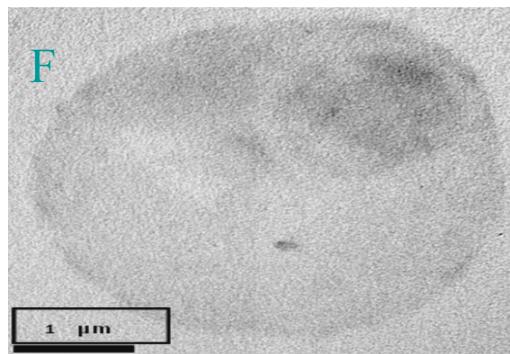
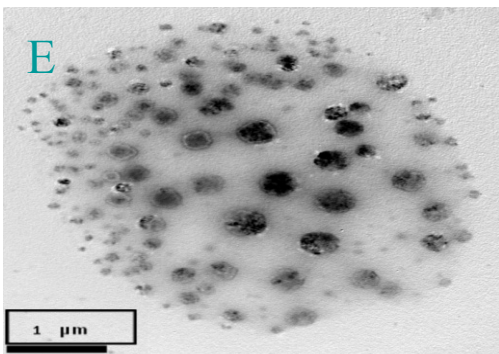
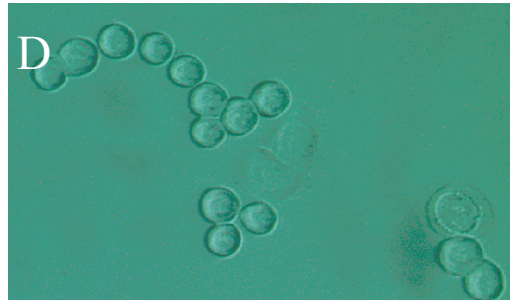
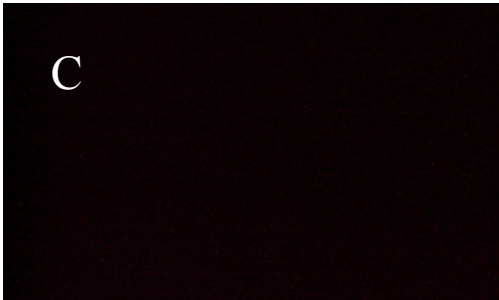
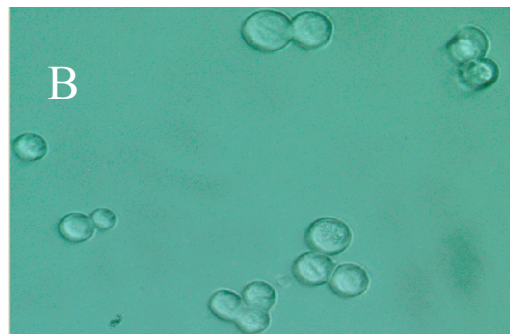
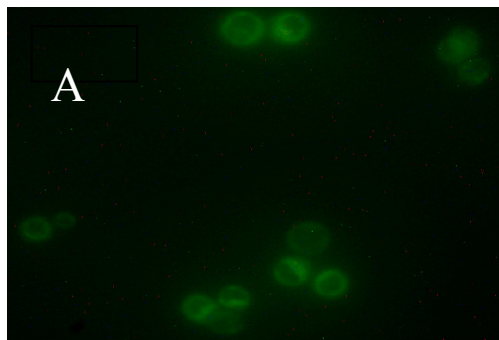


**Raman Imaging System**



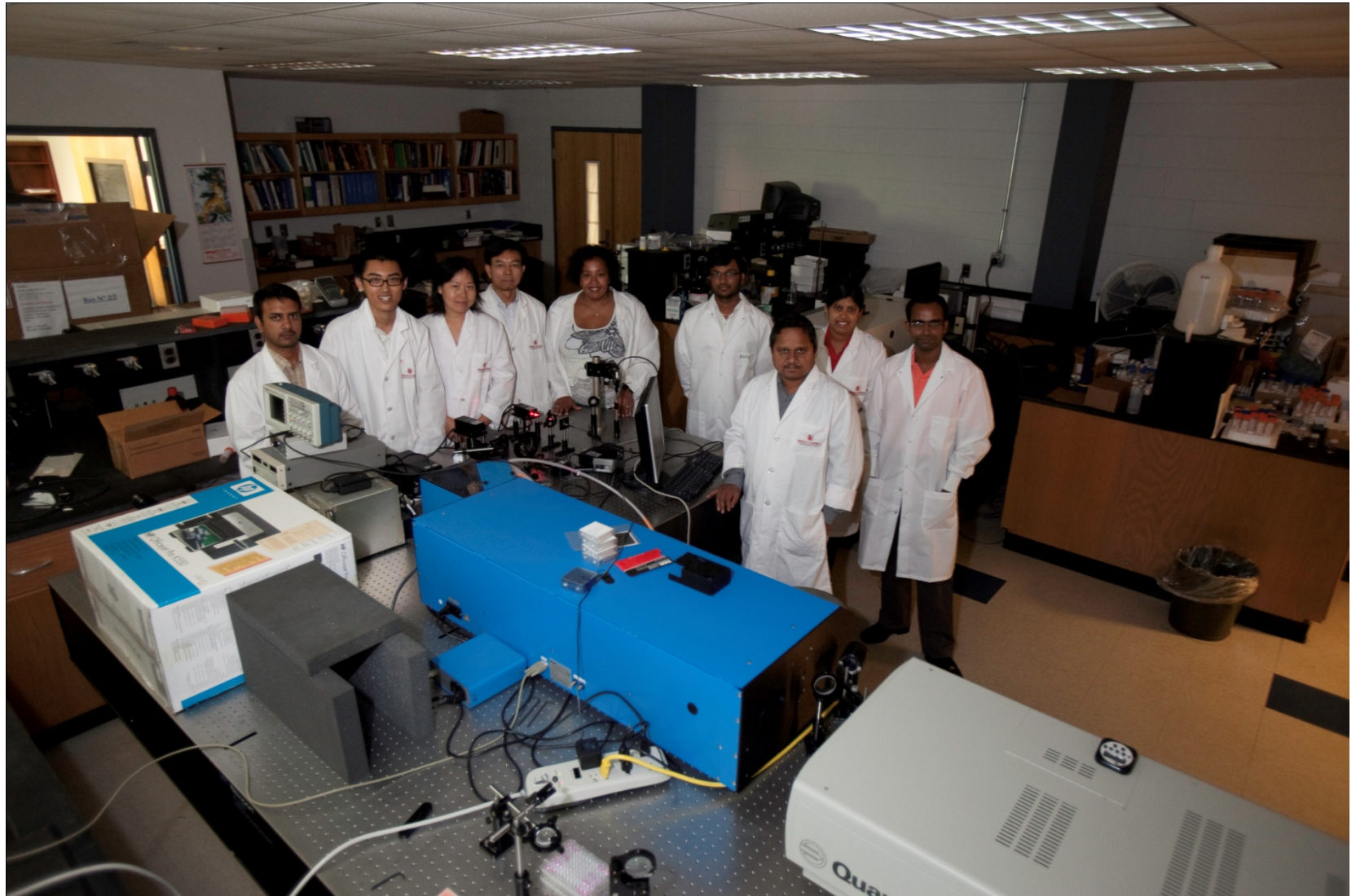
**J. Am. Chem.  
Soc., 2012,  
134, 8662–  
8669**

# Fluorescence Imaging

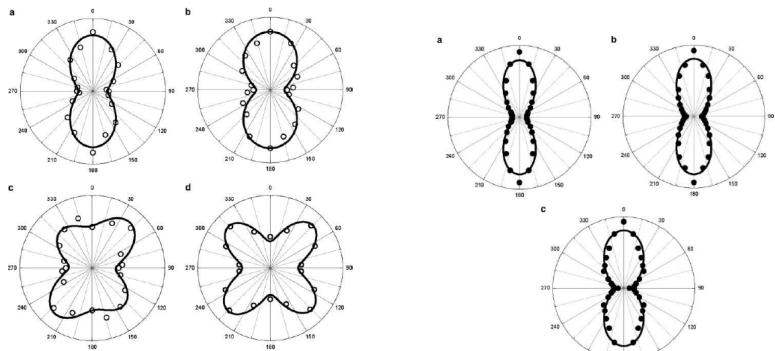


**Fluorescence Imaging**

# Spectroscopy at Nano-Bio Interface Facilities

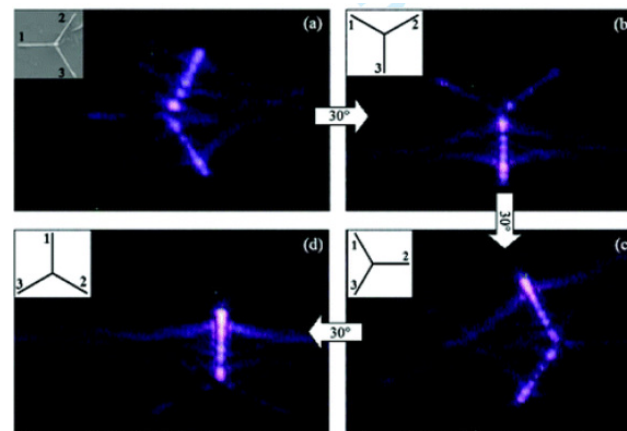


# Second harmonic Generation and Evidence of multipolar contribution



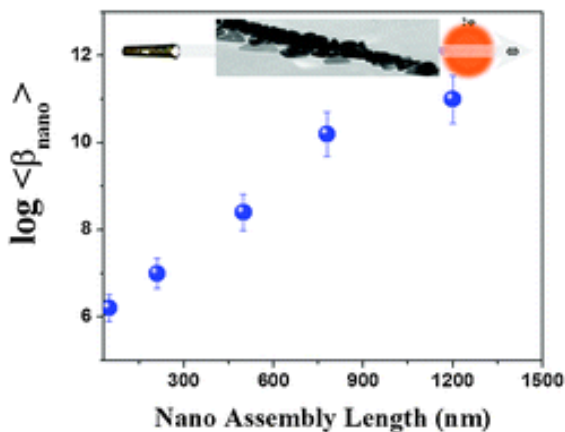
780 nm excitation

1907 nm excitation



*J. Am. Chem. Soc.*; 2008, 130, 8038

*Chemical Review* 2010, 110, 5332–5365



*Chem. Commun.*, 2012, 48, 6034–6036



# JSU Facilities for Bacteria & Cell Characterization

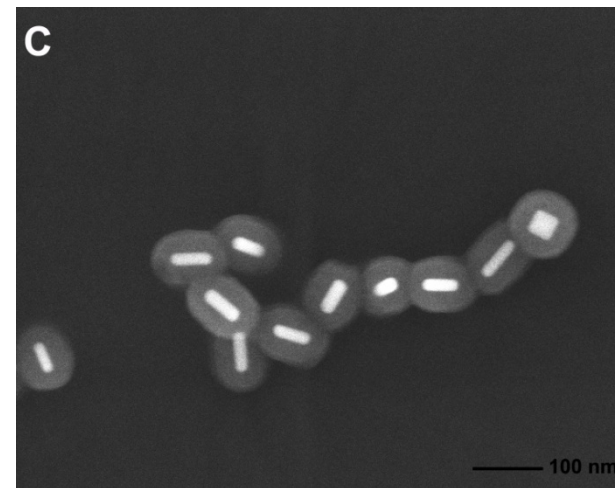
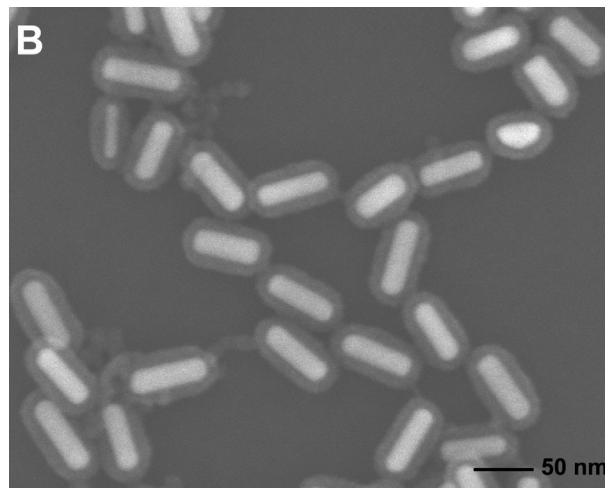
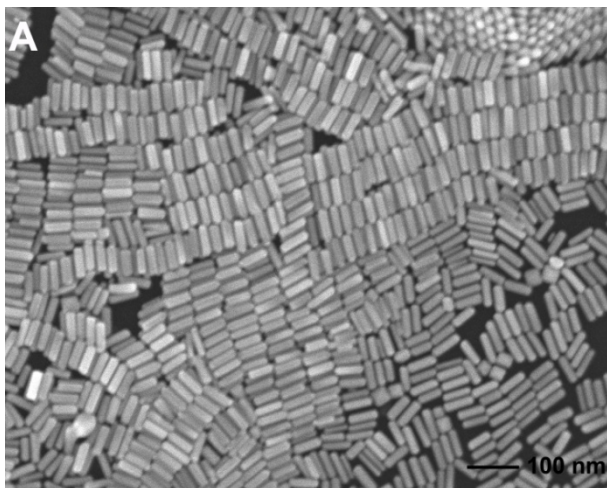
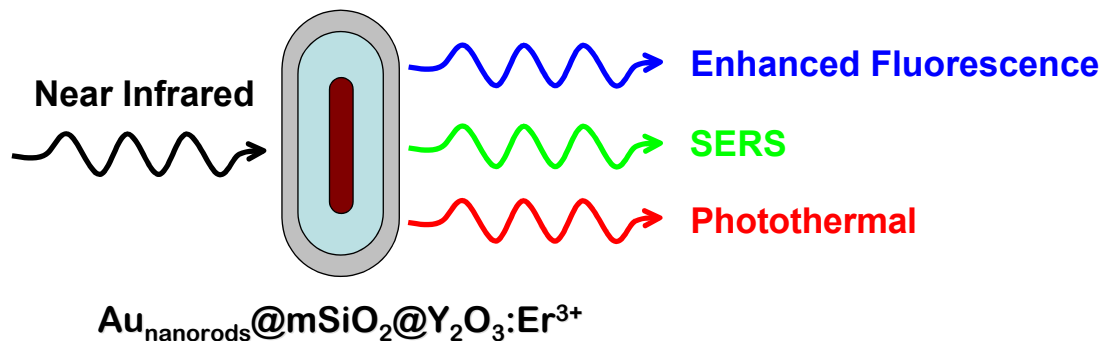


**Comet Single Cell Assay**

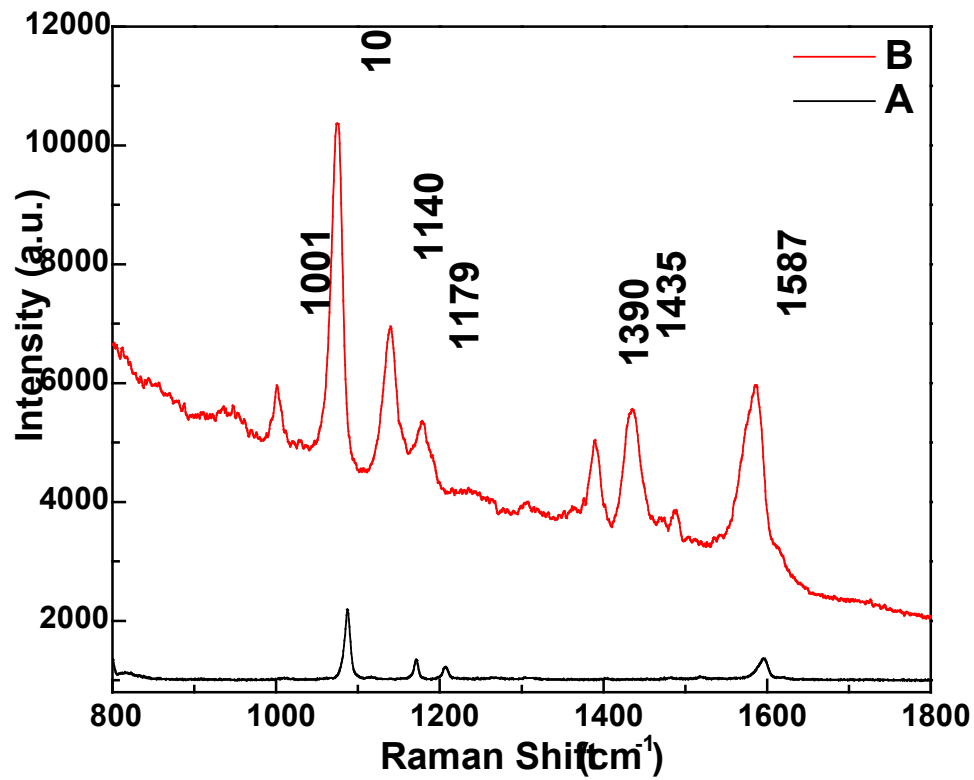


**FV1000 Laser Scanning  
Confocal Microscope**

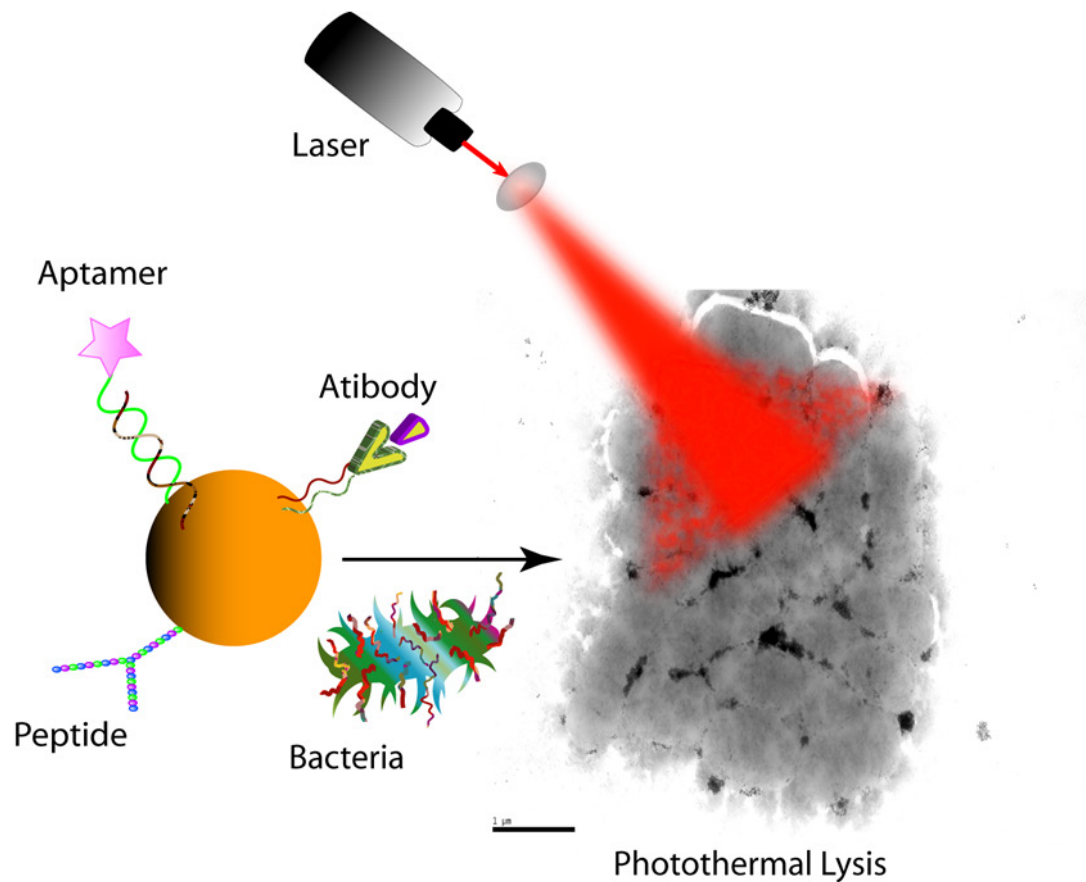
# Multifunctional $\text{Au}_{\text{Nanorods}}@m\text{SiO}_2@Y_2\text{O}_3:\text{Er}^{3+}$ Nanoparticles



# SERS Imaging of Cell

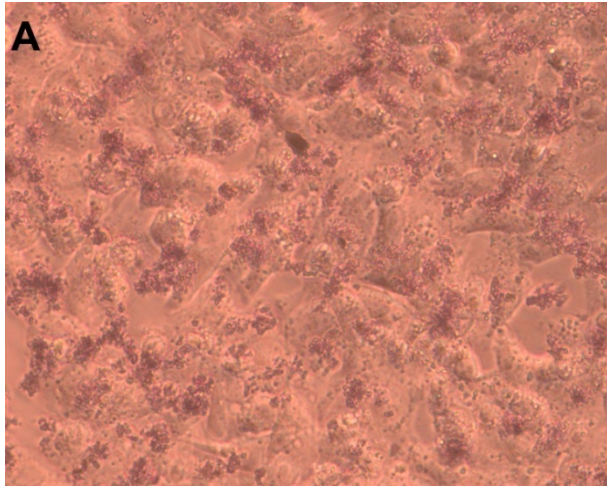


# Photothermal Killing

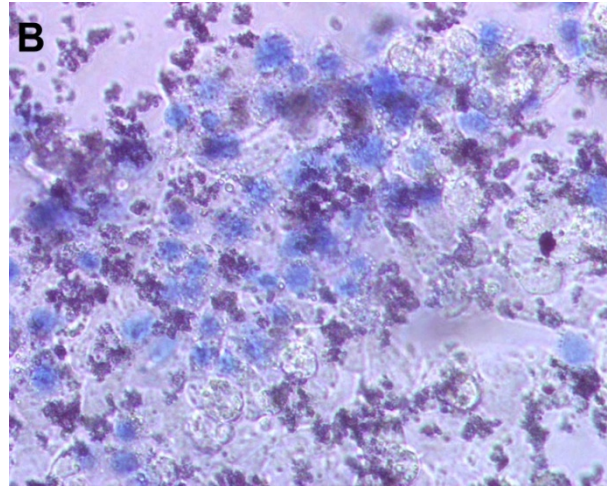


Chemical Society Review, 2012, 41, 3193-3209

# Photothermal Killing



**Before**



**After**

# Our Future Plan



**Willie will visit UTSA for one week to use their microscope facilities.**

**Similarly 1 or 2 students from UTSA-PREM will visit JSU for one week to use our bio-imaging facilities.**

# Conclusions

**We have demonstrated that how PREM-to-PREM interactions can enhance JSU & UTSA PREM materials research and education.**

**We hope that our example will inspire other PREM members for PREM-to-PREM interactions.**

Any Questions?

**Thank you for your kind attention**