

NSF-PREM Presentation

The University of Texas at San Antonio
Partnered with
Northwestern University (MRSEC)

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April 26th 2010



The University of Texas at San Antonio

- Enrollment – Over 29,000 students
- 3rd largest University in Texas and only 2nd in UT System
- Eight Colleges and one Graduate School
- 133 degree programs including 21 doctoral programs
- \$67 million in research and sponsored programs
- Fastest growing university in UT System



Physics and UTSA Infrastructure

- Advanced Engineering and Technology (AET) Building (\$82.5M; December 2009)
 - Physics Department occupies the 3rd floor (over 14,000 square feet of lab space)
- Thin Films Laboratory
- Biophotonics Research and Imaging Laboratory
- Photonic Materials Laboratory
- Biophysics Laboratory
- Nanomaterials Syntheses Labs
- Terahertz Laboratory
- Advanced Microscopy Laboratory
 - TEM-STEM, SEM, AFM, Raman
 - Including the most advanced spherical aberration corrected STEM (JOEL ARM)
- Astronomy Facilities
- Computational Physics Laboratories
 - Access to the Texas Advanced Computing Center (TACC at UT Austin)



Relationship with Northwestern University (MRSEC)

- Summer Research at NU-MRSEC
 - Four UTSA PREM students (two undergraduates and two graduates) have arranged to conduct PREM research at NU over the summer 2010
- Education Outreach Effort between NU and UTSA
 - Summer RET (Research Experience for Teachers) program development at UTSA
- Spring PREM Meetings
 - Seminars given by NU-MRSEC faculty (Dr. Igal Szleifer and Dr. Monica De La Cruz)
 - Interactions with NU-MRSEC faculty
 - Meetings with both UTSA-PREM Faculty and Students
 - Conference Calls
 - Email Communications

UTSA Education and Outreach Efforts

- Currently developing a Research Experience for Teachers (RET) Program with NU-MRSEC
 - Pilot RET will begin Summer 2011 at UTSA
- PREM students participate annually as Judges of the Regional Science Fair in San Antonio
- Hosted Summer Experience Program for Upward Bound High School Students
 - Students worked through modules in the lab with hands-on experiments
 - Absorption and Emission Spectroscopy
 - Absorption and Scattering measurements with integrating spheres



- UTSA department of Physics and Astronomy hosts an annual Biophotonics Symposium in collaboration with The Center for Biophotonics Science and Technology (CBST)

The PREM pipeline for underrepresented groups

- More than 58% of UTSA's students come from minority groups underrepresented in higher education
- 2+2 program with Northwest Vista College (NVC) (95% minority student population)
 - Students complete a 2 year nanotechnology program at NVC and then complete the degree in 2 years at UTSA
- Students from NVC complete semester-long internships in nanotechnology research in the laboratories at UTSA. Currently Jesse Salas and Marcus Najera are working in Dr. Sardar and Dr. Glickman's laboratories.
- Dr. Sardar and Dr. Yacaman serve on the NVC Nanotechnology Program Advisory Board.
- Seminar Series at NVC
 - UTSA faculty, post-doc fellows, and graduate students give hour-long seminar talks to students at NVC

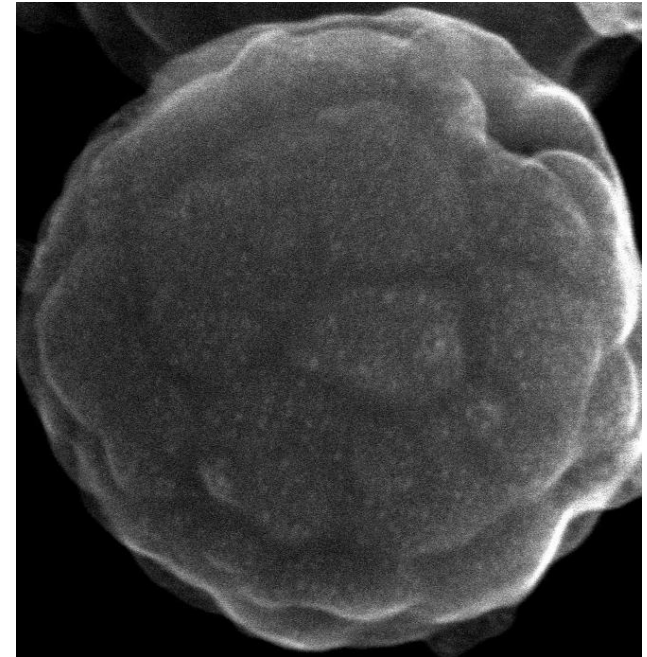
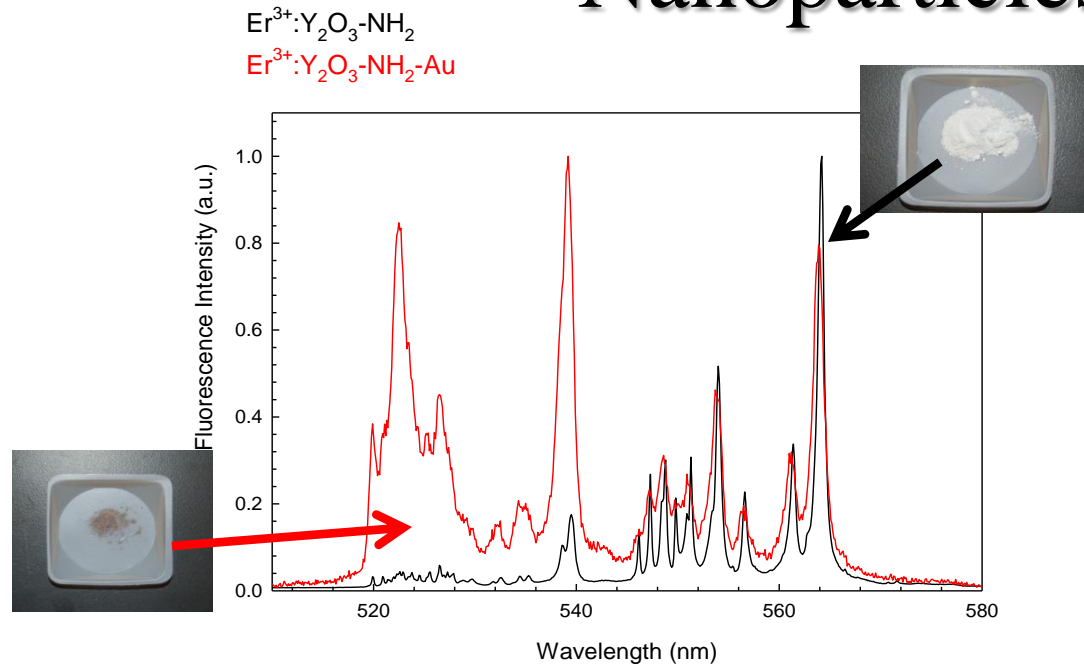
PREM Research Thrusts

- Rare Earth (RE) based Multi-functional Biosensors
- Medical Applications of Nanoparticles - Targeted Contrast Agents
- Novel Characterization Methods to study Biological Tissue using Nanoparticles and state-of-the-art Electron microscopes
- Use of Ag-Au Nanoparticles in Neuroscience
- Terahertz Characterization for Nanomaterials for Biological Imaging
- Power Generation from Thin Films and Fibers functionalized with Pulsed Laser and Atomic Layer Deposition

Science Questions we hope to answer

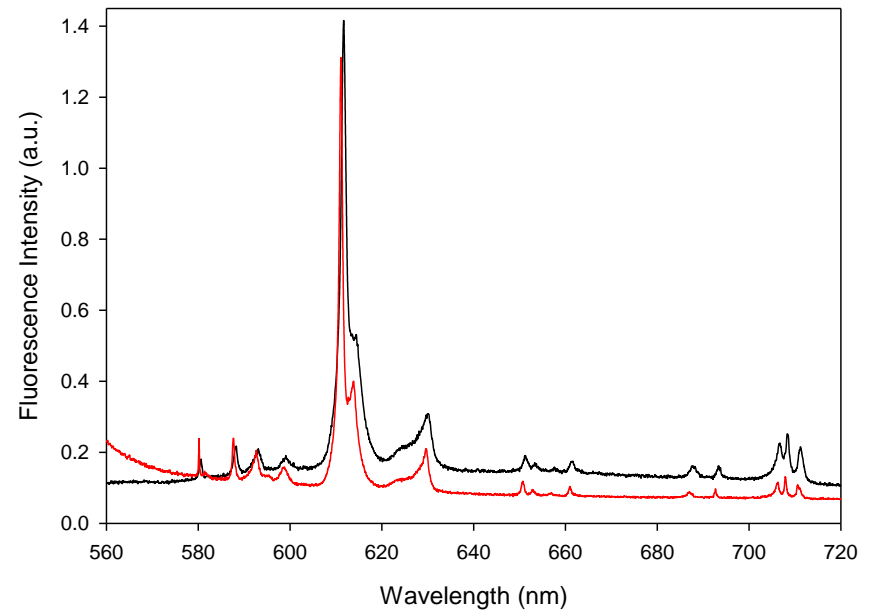
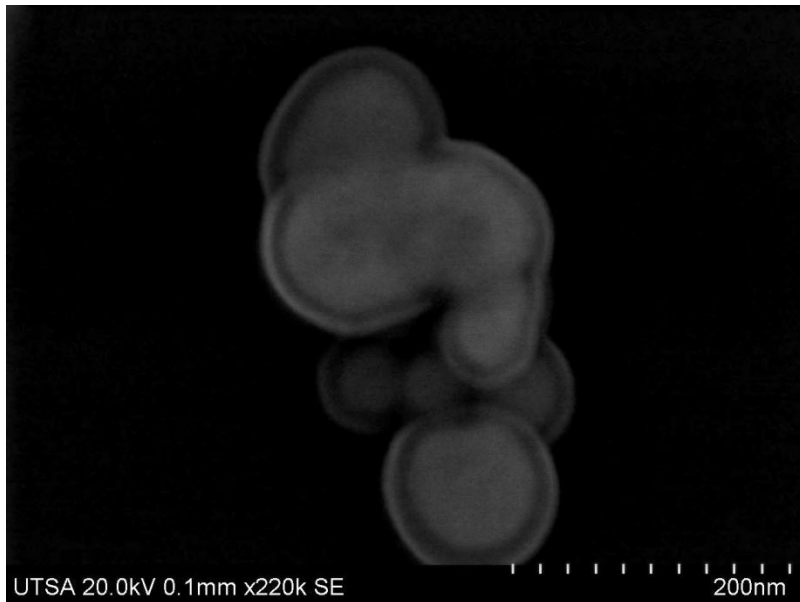
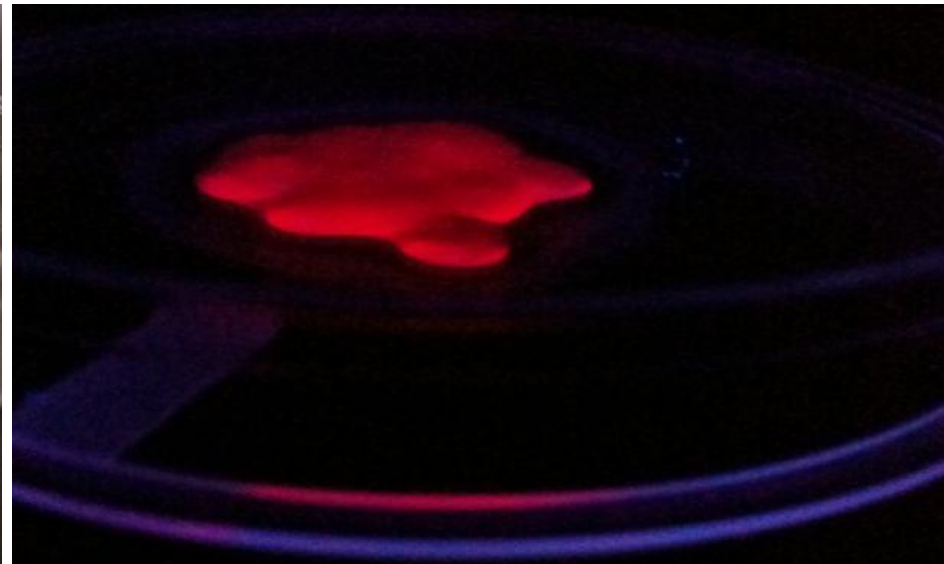
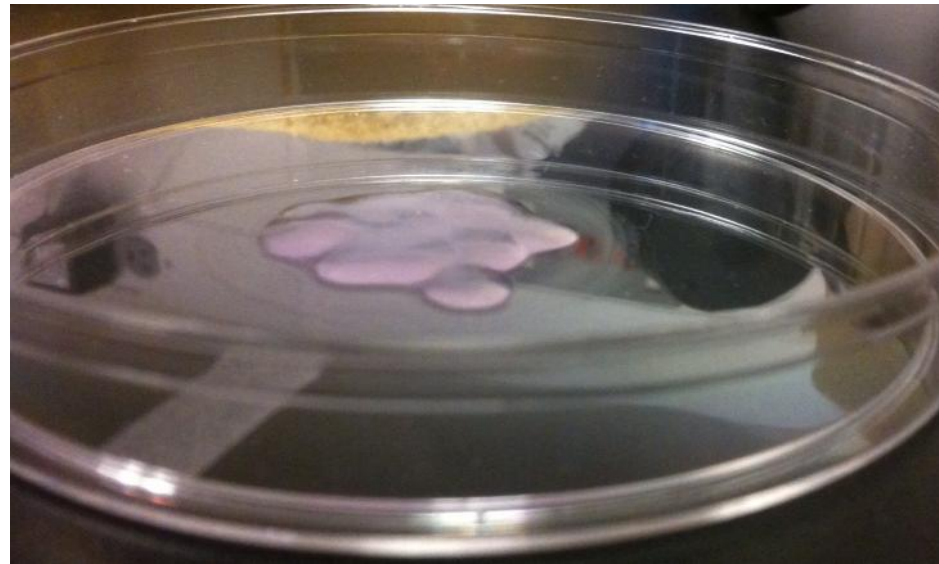
- What are the multi-functional properties of lanthanide doped nanoparticles and how can we exploit these properties in biological applications?
- Are the proposed new characterization methods suitable for studying biological tissues using synthesised nanoparticles and the latest electron microscope?
- What are the effects of Au-Ag nanoparticles on the neuronal tissue and can we use them as intracellular tracers?
- What effect do metallic nanoparticles have in THz imaging applications?
- Can we generate power from synthesized thin films or fibers functionalized with pulsed laser and atomic layer deposition?

Development of Multi-Functional Nanoparticles



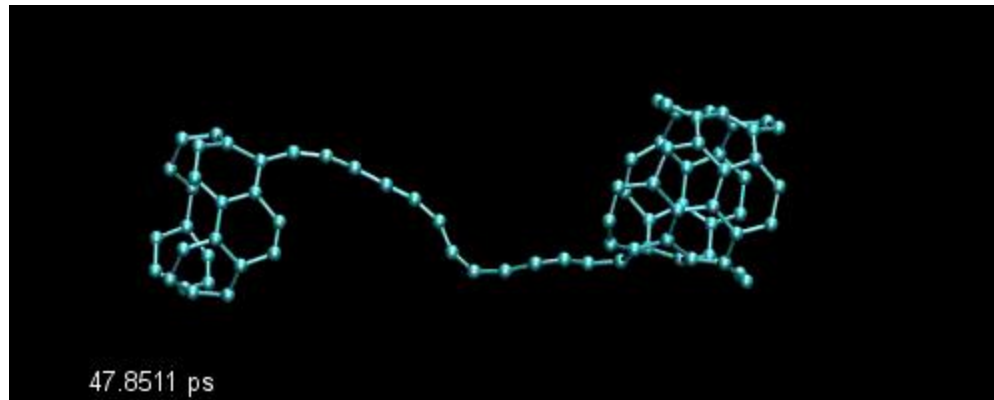
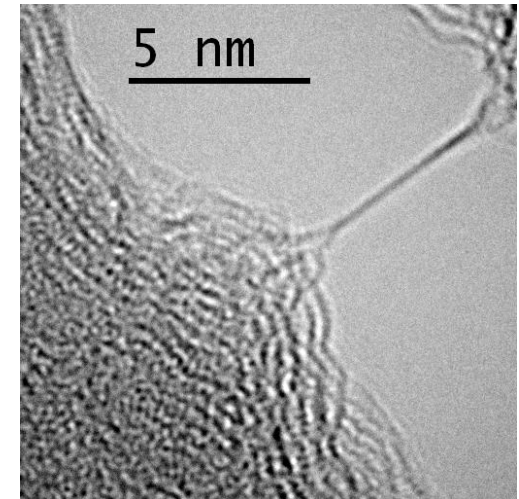
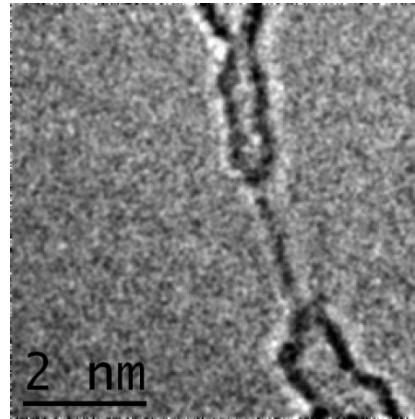
- Huge increase in Er^{3+} fluorescence is observed when gold nanoparticles cover the surface of the Er^{3+} doped yttrium oxide nanoparticles

Gold Core / Silica Spacer / $\text{Eu}^{3+} : \text{Y}_2\text{O}_3$ Shell



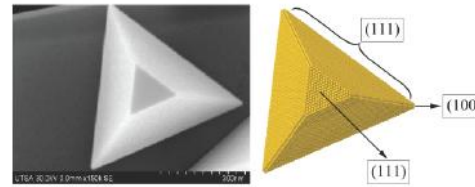
Formation of Carbon Strings

- Allotropes are synthesized by 'breaking' carbon nanotubes to form linear carbon 'nano-necklaces' (carbynes)
- This allotrope is a linear atomic chain of carbon atoms with sp -hybridization. Due to its unique geometry, carbynes are expected to have interesting properties similar to carbon nanotubes and graphene

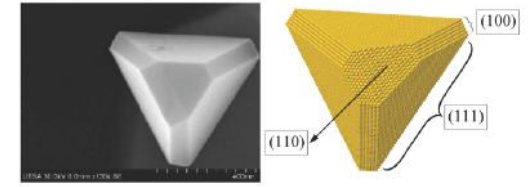


Synthesizing and Modeling Gold Nanostructures

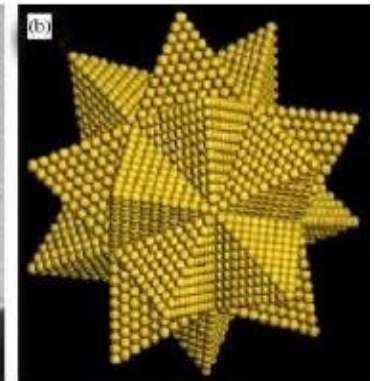
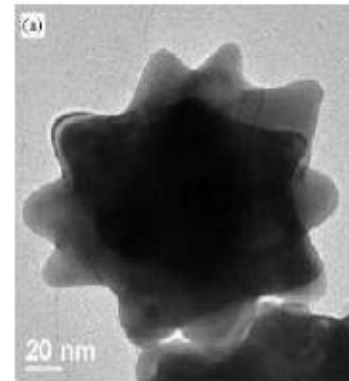
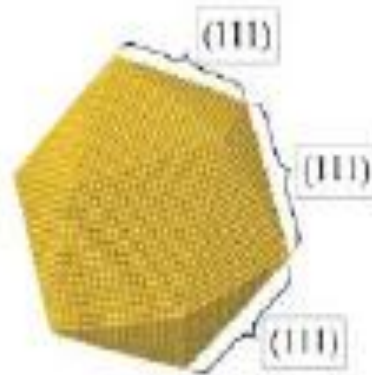
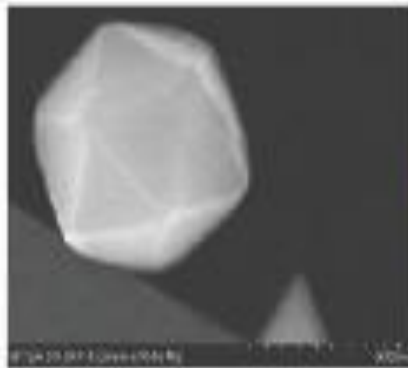
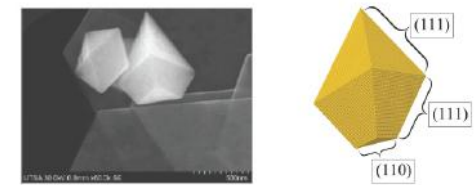
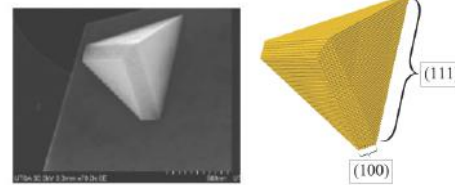
- Recently, progress has been made on understanding the properties of geometrical shapes of gold nanoparticles
- An extensive study based on experimental and theoretical evidence is currently being performed



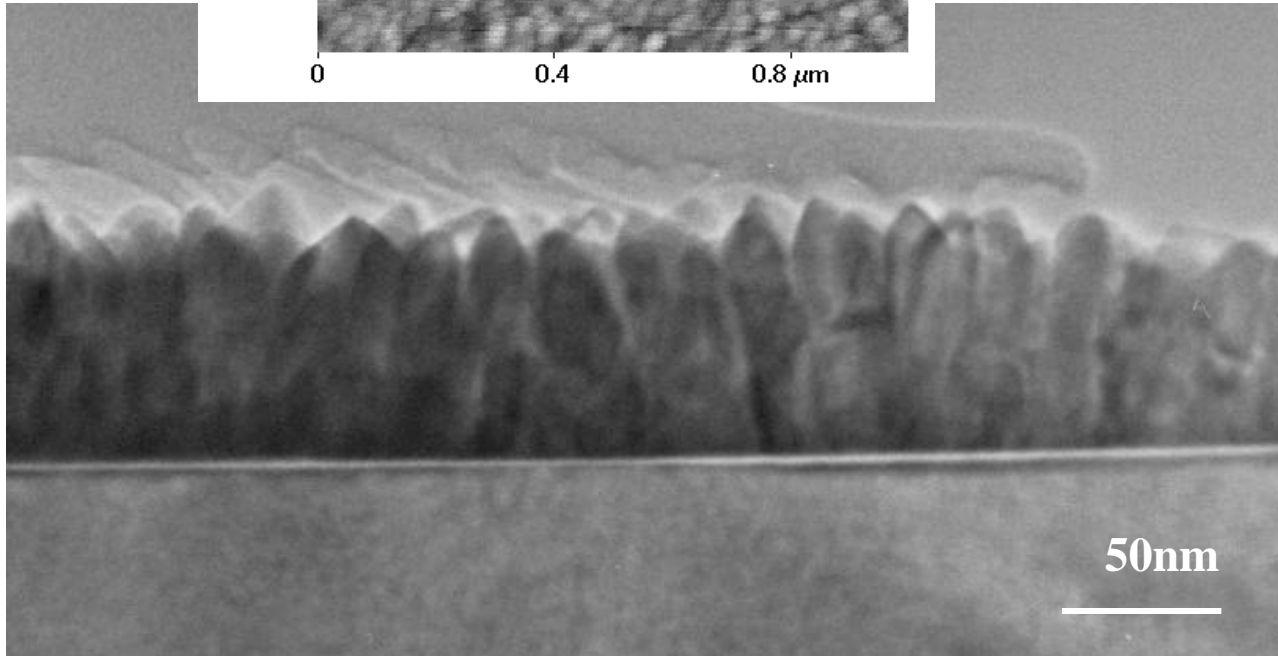
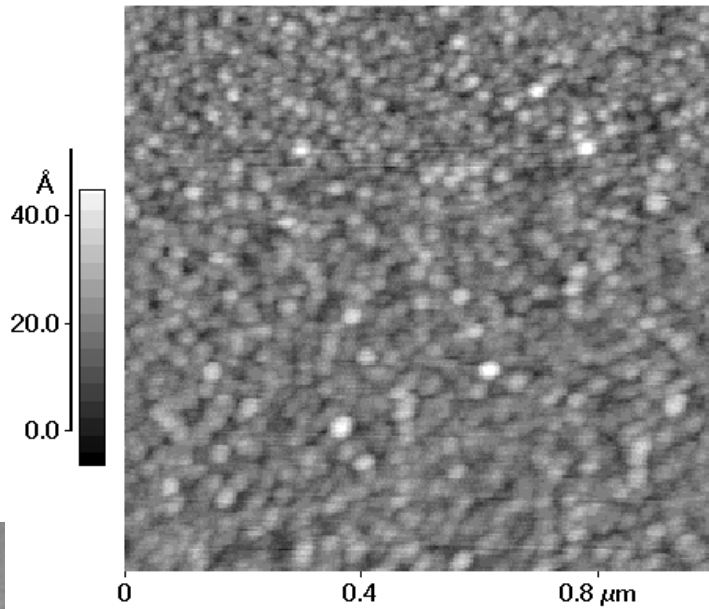
(a)



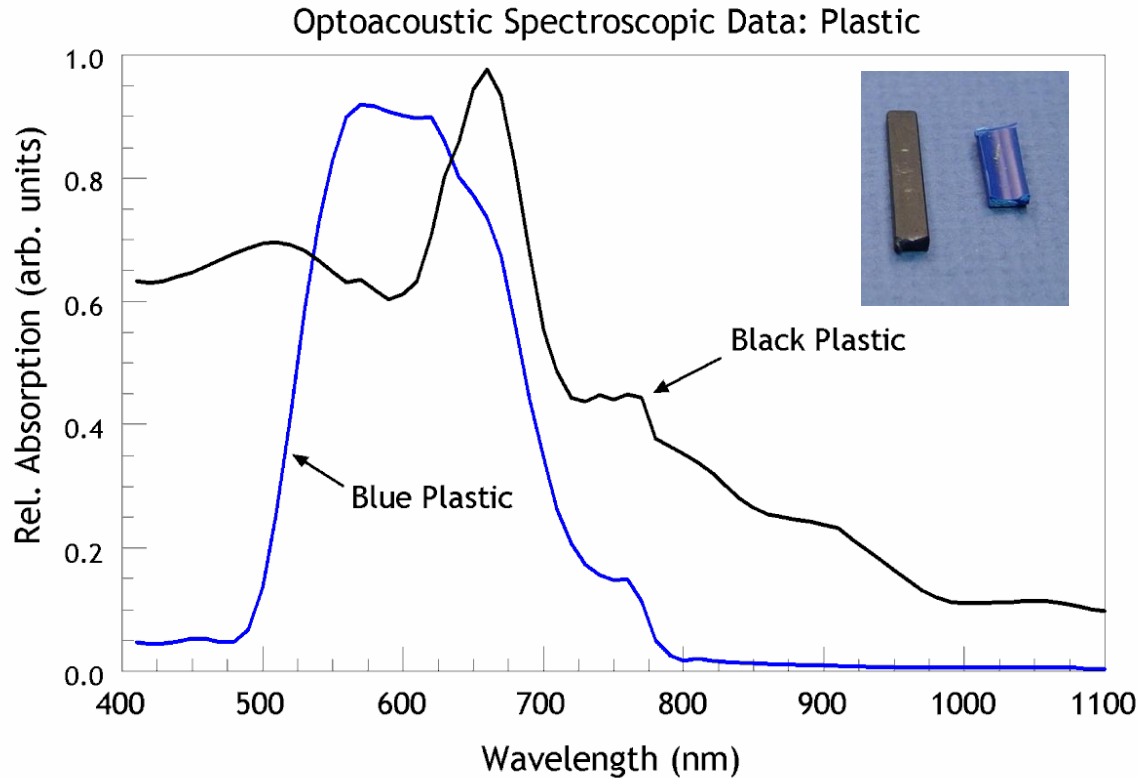
(b)



Self-Assembly of ZnO nanorods on (001) MgO

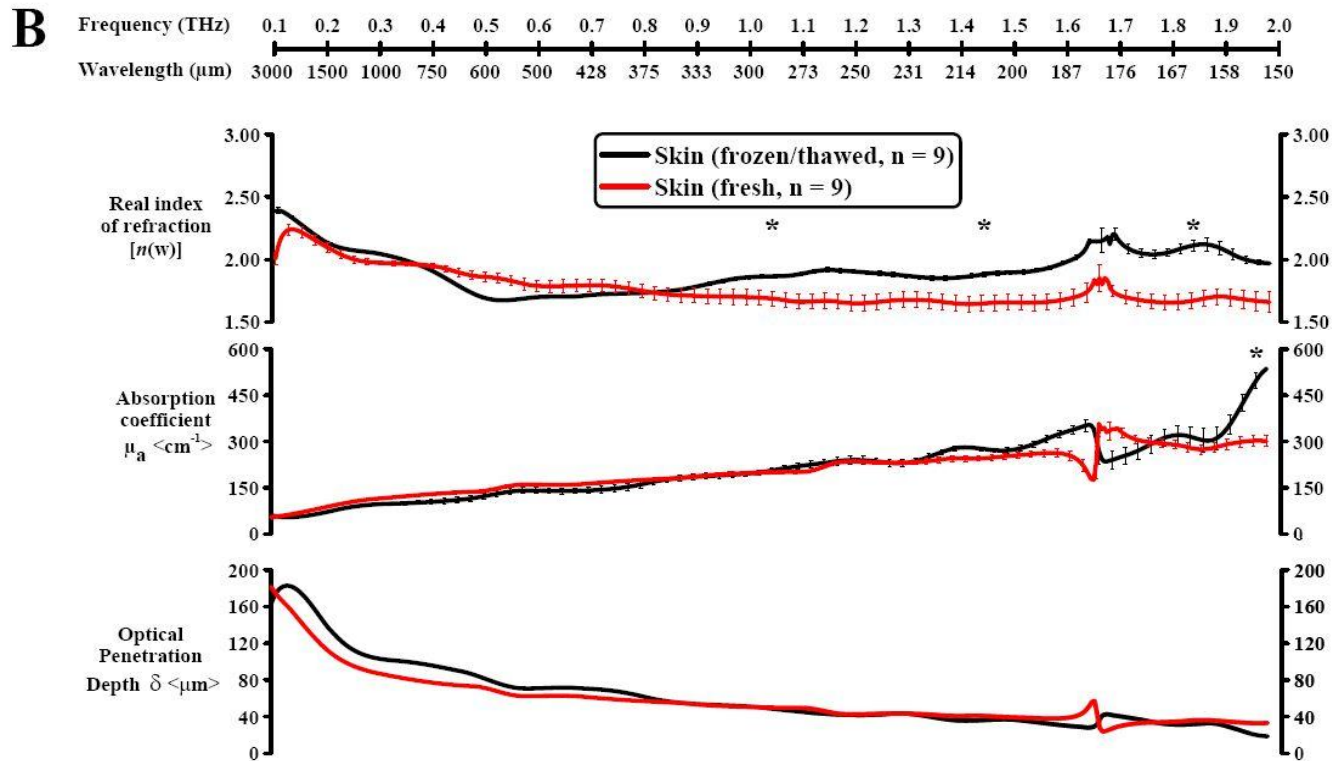


Optoacoustic Imaging to Detect Foreign Bodies

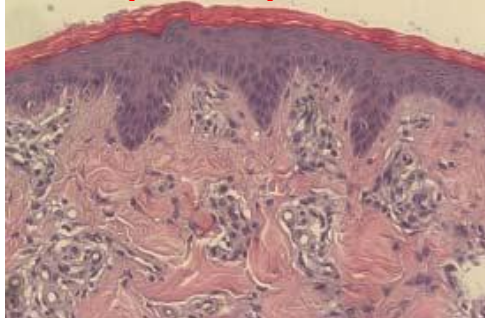


Optoacoustic Comparison of Blue and Black Test Objects

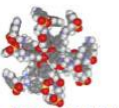
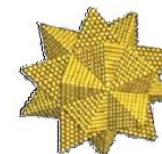
Terahertz Time-Domain Spectroscopy of the Optical Properties of Skin



Skin (Fresh)



Skin (Frozen/thawed)



UTSA PREM Researchers

- Dr. Jianhui Yang
- Erik Enriquez
- Joseph Barrios
- Edward Khachatryan
- Robert C. Dennis
- Leland Page
- Kenneth Ramsey
- Madhab Pokrhel
- Nathan Ray
- Francisco Pedraza
- Devraj Sandhu
- Jesse Salas
- Hector Barron-Escobar
- Marcus Najera



Publications

Published:

- Chandra, S; Deepak, FL; Gruber, JB, et al., “Synthesis, Morphology, and Optical Characterization of Nanocrystalline Er³⁺:Y₂O₃”, J. Phys. Chem C 2010, 114, 874.
- Lin, Y; Dai, C; Li, YR, et al., “Strain relaxation in epitaxial (Pb,Sr)TiO₃ thin films on NdGaO₃ substrates”, App. Phys. Lett. 2010, 96, 102901
- Liu, J; Liu, M; Collins, G, et al., “Epitaxial Nature and Transport Properties in (LaBa)Co₂O₅+delta Thin Films”, Chem. Mater. 2010, 22, 799

Submitted:

- V. H. Romero, C. M. Valdez, M. Jose-Yacamán F. Santamaria. “Single cell photo-thermal ablation of neurons using gold nano-stars”
- G.J. Wilmink, B.L. Ibey, T. Tongue, B. Schulkin, N. Laman, X. Peralta, L. X. Cundin, B.D. Rivest, and W.P. Roach, “Development of a Terahertz Time-Domain Spectroscopy Device for the Measurement of the Optical Properties of Skin”, submitted to the journal of Biomedical Optics.
- M. Pokhrel, R.C. Dennis, K. Nash, D.K. Sardar, R. Debnath. “Judd –Ofelt analysis of Er³⁺/Yb³⁺ (co-doped) ions in a tellurite glass”

Presentations

- Page, L., Maswadi, S., Glickman, R. D., "Optoacoustic spectroscopic imaging of radiolucent foreign bodies," Proceedings of SPIE Vol. 7629, 76290E (2010).
- Xomalin G. Peralta, Michael C. Wanke, Igal Brener, Jerry Waldman, William D. Goodhue, J. Li, Abul K. Azad, Hou-Tong Chen, Antoinette J. Taylor, John F. O'Hara, "Metamaterial based devices for terahertz imaging", Proceedings of SPIE BIOS 2010 (2010).
- Danielle R. Dalzell, Jill McQuade, Rebecca Vincelette, Bennett Ibey, Jason Payne, Robert Thomas, William P. Roach, Caleb L. Roth, Gerald J. Wilmink, "Damage thresholds for terahertz radiation", Proceedings of SPIE BIOS 2010 (2010).
- Gerald J. Wilmink, Bennett L. Ibey, Thomas Tongue, Brian Schulkin, Xomalin Peralta, Benjamin D. Rivest, Eric C. Haywood, and William P. Roach. "Measurement of the Optical Properties of Skin Using Terahertz Time-Domain Spectroscopic Techniques", Proceedings of SPIE BIOS 2010 (2010).
- Gerald J. Wilmink, Bennett L. Ibey, Caleb L. Roth, Rebecca L. Vincelette, Benjamin D. Rivest, Christopher B. Horn, Joshua Bernhard, Dawnlee Roberson, William P. Roach, "Determination of Death Thresholds and Identification of Terahertz (THz)-Specific Gene Expression Signatures", Proceedings of SPIE BIOS 2010 (2010).
- Gerald J. Wilmink, Benjamin D. Rivest, Bennett L. Ibey, Luisiana X. Cundin, Eric C. Haywood, William P. Roach, "The optical properties of biological tissues in the terahertz wavelength Range", Proceedings of SPIE BIOS 2010 (2010).
- Gerald J. Wilmink, Benjamin D. Rivest, Bennett L. Ibey, Caleb L. Roth, Joshua Bernhard, William P. Roach, "Quantitative Investigation of the Bioeffects Associated with Terahertz Radiation", Proceedings of SPIE BIOS 2010 (2010).