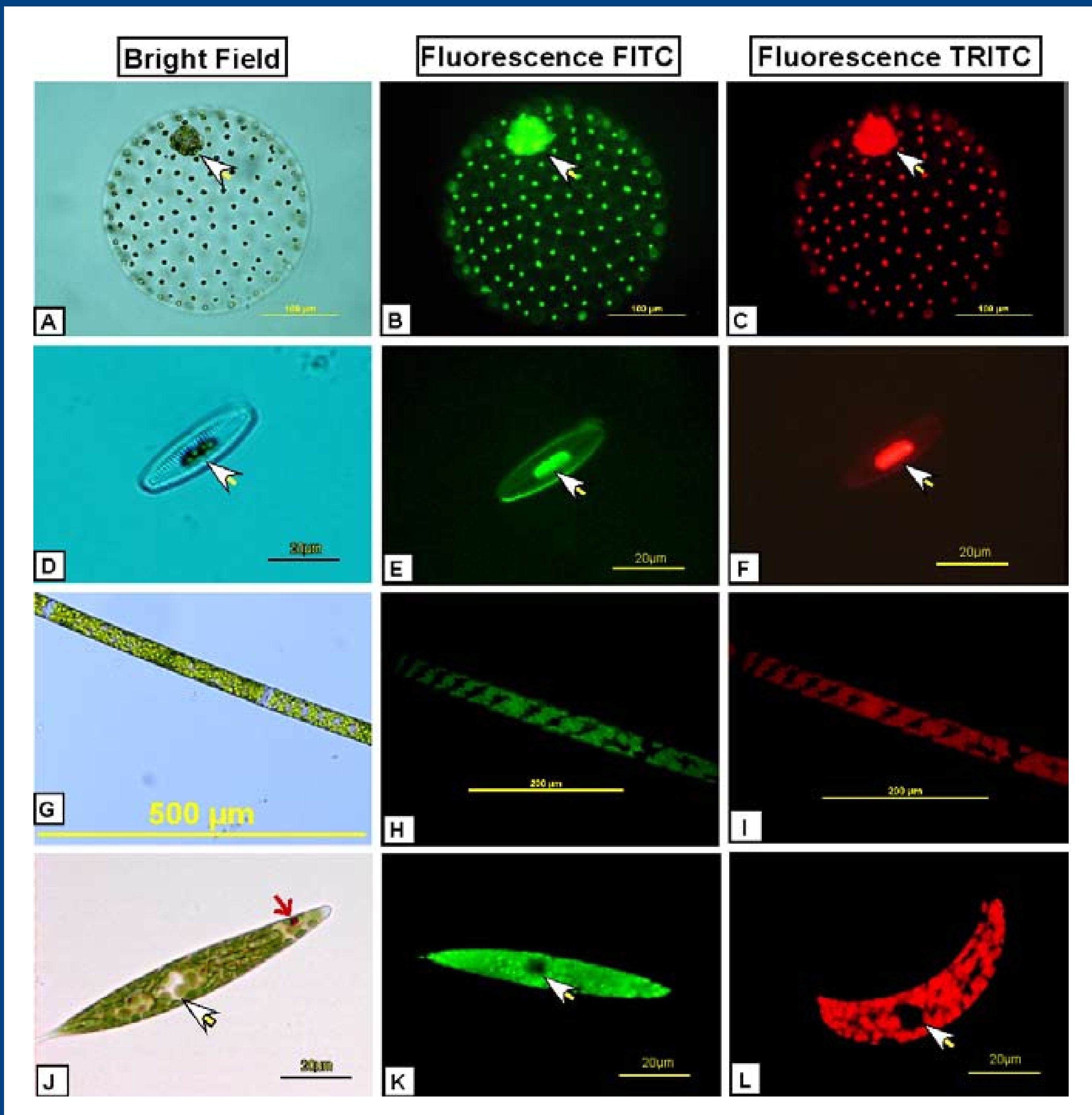
Texas Journal of Microscopy



Volume 45, Number 1, 2014 • ISSN 1554-0820
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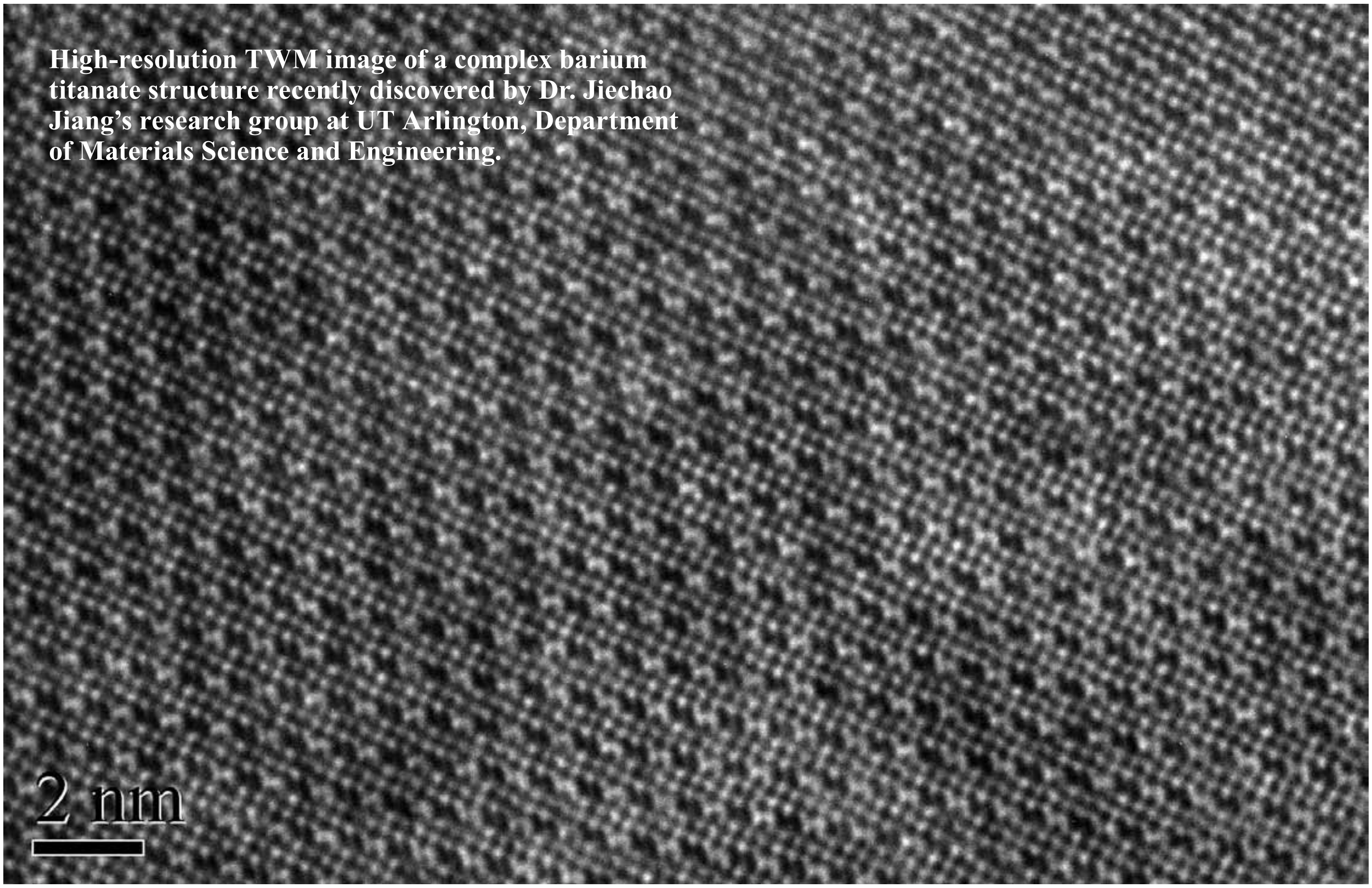
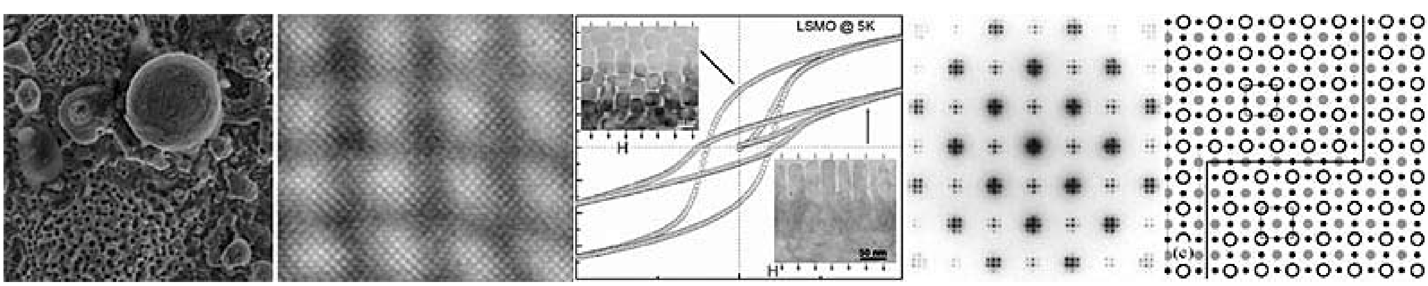


High-resolution TWM image of a complex barium titanate structure recently discovered by Dr. Jiechao Jiang's research group at UT Arlington, Department of Materials Science and Engineering.



The workshops of the 2014 TSM annual meeting were held at the Characterization Center for Materials and Biology (C2MB) of The University of Texas at Arlington.

Contents

TEXAS JOURNAL OF MICROSCOPY
VOLUME 45, NUMBER 1, 2014
ISSN 1554-0820

Camelia Maier and Nabarun Ghosh, Editors

Official Journal of the Texas Society for Microscopy
"TSM - Embracing all forms of microscopy"
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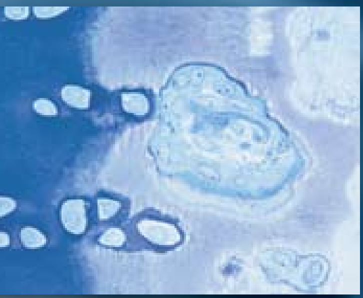
ADVERTISER INDEX

ON THE COVER

Phytoplankton species visualized with bright field, TRITC and FITC. A-C, *Volvox globator* colony; arrows indicate daughter colony. D-F, The pinnate diatom *Navicula* sp.; arrows indicate the central nodule. G-I, *Spirogyra* sp. J-L, *Euglena acus;* white arrow indicates the nucleus and the red arrow points to the eye spot. Specimens were stained in the dark with Fluorescein (Thermo Scientific) for 3-4 minutes, mounted on a slide and observed with a BX-40 Olympus microscope. All micrographs were captured at 40X. Fluorescent micrographs were captured using FITC (green) and TRITC (red) filters with a mercury lamp source. **Nabarun Ghosh, Department of Life, Earth and Environmental Sciences, West Texas A&M University, Canyon, Texas, 79015.**



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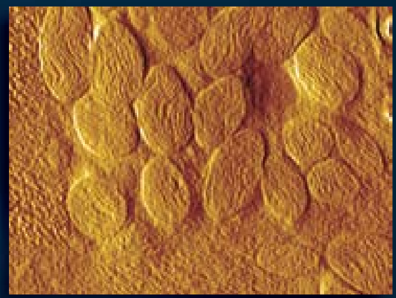

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President's Message

Welcome to a new year of the Texas Society for Microscopy, which happens to be the Society's 50th anniversary! TSM strives to promote and encourage the knowledge, science and practice of all forms of microscopy, imaging and compositional analyses for a variety of scientific disciplines and educational purposes. TSM, an affiliate of Microscopy Society of America (MSA), is a non-profit organization run by volunteers who work very hard for the good of the Society. TSM is not a large society, yet is financially healthy at this point in time due to the strong support of its regular, student and corporate members. I want to thank all those people who contributed to TSM from its very beginnings 50 year ago, who through the years, have donated their time and energy to Society activities. Thanks to those members, TSM exhibits the ultimate in scientific professionalism and fiscal integrity, which makes me very proud as I am finishing my last term as TSM President. Special thanks to our Corporate Sponsors! The annual meetings would not be possible without their generosity and participation.

In the past year we had several accomplishments. A newly designed website which follows the MSA website template at www.texasmicroscopy.org was adopted and updated often. The 2013 meeting in Irving with the workshop at Hitachi High Technologies America, Inc. was a success. The Society succeeded in recruiting a significant number of presenters for the 2014 meeting for a record number of 43 presentations. A whole day of workshops was organized by Tom Levesque, President of Technology Business Consulting Co. and Angelique Graves and Kim Rensing of Leica Microsystems, Inc. For students, TSM offers financial assistance for participation at meetings and sponsors monetary prizes for presentation contests. Starting this year, TSM initiates a mini-grant program open to all students at colleges and universities across Texas who are interested in employing ANY microscopy technique as the principal investigative tool in their research. More details on the mini-grant program will come soon on the Society website and Facebook. Your input and suggestions for further initiatives are especially welcome.

All these accomplishments were the result of dedicated work by a handful of Executive Council members, who most of the time wore multiple hats in taking care of the Society's business and to whom I am very grateful. Those active members in the Executive Council, apart from the President, were: Jiechao Jiang, President Elect, who also served as Webmaster and helped with the program; Jennie Wojtaszek, Secretary; David Garrett, Treasurer; Nabarun Ghosh, Facebook Master and helped with the 2014 issue of the Texas Journal of Microscopy; and Laura Hanson, appointed member in the Program Chair Committee. The President did most of the Program Chair and Journal Editor work. The reality is that we can not run a society, even a small one like TSM, with 4 elected and 2 appointed officers out of the regular number of 14 members in the Executive Council. At this point in time, we need to elect the following TSM officers: President Elect, Secretary Elect, Secretary Elect, Treasurer Elect, Program Chair, Program Chair Elect. We also need to appoint the Corporate Member Representative, Student Representative, Journal Editor, and Webmaster. I am appealing to all TSM members to please run for office and volunteer for the appointed positions. In the coming year, which is the year of the Society's 50th anniversary, there will be opportunities for everyone to continue in this community spirit, and I encourage you all to do so. Jiechao Jiang will lead the Society during the anniversary year. Please, come forward and support his presidency. As for me, I will still report for duty and actively contribute to the Society's activities as Past President.

TSM must reach out to more people in our great state of Texas, who utilize microscopes of many shapes and forms in their research, job and educational activities. We encourage students, researchers, professors, science teachers, developers and innovators of microanalysis instrumentation, techniques, and applications to join in the life of our Society and its mission. We need new generations of microscopists to successfully take the Texas Society for Microscopy into the next fifty years of activity and re-shape it into a vibrant and engaging professional society.

Happy Anniversary Texas Society for Microscopy and bright hopes for the future!

Sincerely,

Camelia Maier
TSM President 2013

Abstracts

MATERIALS SCIENCE
SPRING 2014

CHEMICAL IMAGING BEYOND THE DIFFRACTION LIMIT. ANDREA CENTRONE, National Institute of Standard and Technology, Center for Nanoscale Science and Technology, Gaithersburg, MD.

Infrared (IR) microscopy can assess the chemical composition of materials, but its lateral resolution is limited by diffraction to several micrometers because of the long IR wavelengths (2-16 µm) thus precluding IR imaging at the nanoscale. Photo Thermal Induced Resonance (PTIR) is a new technique that circumvents the diffraction limit by employing a tunable pulsed laser for sample illumination and an AFM tip as a local detector to measure the instantaneous thermal expansion induced by light absorption in the sample. Local IR spectra and maps are obtained by plotting the amplitude of the tip deflection with respect to the laser frequency and position, respectively. Notably, the PTIR spectra can be compared with IR spectral databases directly enabling materials identification at the nanoscale.

In this talk, I will describe the working principles of the PTIR technique and I will use nano-patterned polymer samples to evaluate the technique lateral resolution, sensitivity and linearity. I will demonstrate that the PTIR signal intensity is proportional to the local absorbed energy. Notably, the intensity of the PTIR spectra of thin films (< 1 µm) depends linearly on the sample thickness suggesting that PTIR may be applied for quantitative chemical analysis at the nanoscale.

In the second part of the talk, I will apply the PTIR technique to characterize different nanomaterials and show how the local results gathered can provide insightful information and possibly help to engineer nanomaterials for greatest efficacy. Examples will include recent work from my lab, such as i) imaging and quantifying plasmonic near-field hot-spots, ii) imaging and spectroscopy of near-field plasmonic modes, and iii) imaging of phase separated domains in Metal-Organic Frameworks materials.

CHARACTERIZATION STUDIES OF THE NANODIAMONDS OBTAINED FROM PET. ALENA BORISOVNA KHARISSOVA*, EDGAR DE CASAS ORTIZ, OXANA V. KHARISSOVA, and U. ORTIZ MENDEZ, Universidad Autónoma de Nuevo Leon, Monterrey, Mexico. E-mail bkhariss@hotmail.com.

Polymers are used in our daily life. Some materials, such as PET [polyethylene terephthalate, $(C_{10}H_8O_4)_n$], present in beverage and other liquid containers, and in resins in combination with glass fiber in boats among other applications, are usually thrown away after use and are hard to be degraded in the environment. However, this material can be recycled and used to acquire nanostructures. During this investigation, the objective was to obtain nanoparticles and carbon-based nanostructures from PET polymers by means of microwave irradiation at temperatures of 220-280°C and normal pressure and at 600 psi in the presence of acids, ethylene glycol and by calcination. The obtained nanoparticles were studied by scanning electron microscopy (SEM), high-resolution transmission electron microscopy (HRTEM), and Raman spectroscopy. The obtained nanoparticles possess nanodiamond structure of 10-20 nm size range.

DISPERSION OF CARBON NANOTUBES IN WATER AND NON-AQUEOUS SOLVENTS. BORIS I. KHARISOV* and OXANA V. KHARISSOVA, Universidad Autónoma de Nuevo León, Monterrey, Mexico. E-mail bkhariss@hotmail.com.

Contemporary methods (bibliographic review) for dispersion of carbon nanotubes (CNTs) in water and non-aqueous media are discussed. Main attention is paid to ultrasonic, plasma techniques and other physical techniques, as well as to the use of surfactants, functionalizing and debundling agents of distinct nature (elemental substances, metal and organic salts, mineral and organic acids, oxides, inorganic and organic peroxides, organic sulfonates, polymers, dyes, natural products, biomolecules, and coordination compounds). Special studies on CNTs solubilization are examined. The described methods for CNTs "solubilization" allows: a) to elaborate novel techniques for CNTs functionalization in distinct aqueous and organic media; b) to find additional applications for apparently "insoluble" CNTs, in particular for drug delivery and sensor purposes; c) to expand possible uses of CNTs via creation of their nanocomposites with metals, oxides, polymers and their addition to a variety of industrial products as, for instance, cement, leather, textile or electric cable isolators; d) to vary their toxicity by addition/functionalization of organic molecules and pharmaceutically-active species.

NOVEL METHOD FOR SYNTHESIS OF Fe CORE AND C SHELL MAGNETIC NANOPARTICLES. RAKESH P. CHAUDHARY*, S. K. MOHANTY and ALI R. KOYMEN, Department of Physics, University of Texas at Arlington, Arlington, Texas 76019.

Using a newly developed method, carbon-encapsulated iron (Fe) nanoparticles were synthesized by plasma due to ultrasonication in toluene. Fe core with carbon shell nanoparticles were characterized using Transmission Electron Microscopy (TEM) and High Resolution Transmission Electron Microscopy (HRTEM). Fe nanoparticles of 7-115 nm in diameter are encapsulated by 7-8 nm thick carbon layers. There was no iron carbide formation observed between the Fe core and the carbon shell. The Fe nanoparticles have body centered cubic (bcc) crystal structure. Synthesized nanoparticles showed a saturation magnetization of 9 $A.m^2/kg$ at room temperature. After thermal treatment, crystalline order of the nanoparticles improved and saturation magnetization increased to 24 A.m^2/kg. We foresee that the carbon-encapsulated Fe nanoparticles are biologically friendly and could have potential applications in Magnetic Resonance Imaging (MRI) and photothermal cancer therapy.

SYNTHESIS OF Fe NANOWIRES VIA A NOVEL APPROACH. KINJAL H. GANDHA*, KEVIN ELKINS, and J. PING LIU, Department of Physics, University of Texas at Arlington, Arlington, Texas 76019.

Iron nanowires with high magnetization and high coercive force were fabricated via reduction of as-synthesized α-FeOOH nanowires. Thermal treatment was used to facilitate subsequent phase transformation from the precursor to α-Fe phase. Increasing reduction time and temperature led to agglomeration and sintering of the nanowires. By using fluid bed technique and by adjusting the reaction temperature, time and gas component in the process of heat treatment, α-Fe nanowires with length of 200 nm–300 nm and diameter of 20 nm–30 nm were prepared. The iron nanowires had a coercive force of 628 Oe and saturation magnetization of 197 emu/g at room temperature. This novel process is effective to produce iron nanowires with well controlled morphology and composition.

FABRICATION OF SOLID-STATE NANOPORES WITH TRANSMISSION ELECTRON MICROSCOPY. MOHAMMAD RAZIUL HASAN*[abc], NUZHAT MANSUR[abc] and SAMIR M. IQBAL[abcd], [a]Nano-Bio Lab, [b]Department of Electrical Engineering, [c]Nanotechnology Research Center, [d]Department of Bioengineering, University of Texas at Arlington, Arlington, Texas 76019. SMIQBAL@uta.edu

Transmission electron microscope (Hitachi H-9500 High-Resolution TEM) was used to drill nanopores in silicon nitride (SiN) membranes. The process provided a simple and fast approach with precise control over the nanopore dimensions. Nanopores with diameters ranging from 15 nm to 50 nm were fabricated in SiN membranes using this approach. The fabrication started with a single silicon wafer deposited with 500 nm thick silicon-nitride layer on both sides. Etch windows were created on one side of the wafer with photolithography followed by an anisotropic etch of substrate material with TMAH to create suspended SiN membranes (70x70 um^2). The quality and dimension of the membranes were examined with confocal microscope (Zeiss LSM 5 Pascal). The thickness of the membranes was precisely measured with ellipsometer and was reduced down to 20 nm with reactive ion etching (RIE). The stress on the thin membranes was minimized by thermal annealing. The membranes were then transferred into TEM and a single pore was drilled in each membrane with high energy (typically 200-300 keV) focused electron beam. The diameter of the nanopore was controlled with beam intensity, beam size and exposure time. The nanopore-devices can be used for rapid detection and characterization of disease biomarkers or DNA molecules at the single molecule level. In addition, these artificial pores can also be used to mimic biological ion channels to understand ion transport mechanisms.

CHARACTERIZATION OF NANOTEXTURED PDMS FOR CANCER CELL ISOLATION. MUHYMIN ISLAM*[1,2,3], YOUNG-TAE KIM[2,4] and SAMIR M. IQBAL[1,2,3,4], [1]Nano-Bio Lab, [2]Nanotechnology Research Center, [3]Department of Electrical Engineering, [4]Department of Bioengineering, University of Texas at Arlington, Arlington, TX 76019.

Isolation of circulating tumor cells (CTCs) from blood in the early stages of cancer is very challenging because of their very low concentration. Nanotextured polydimethylsiloxane (PDMS) substrates have been characterized using Atomic Force Microscopy (AFM), and cell growth on these nanotextured substrates has been quantified using fluorescence and scanning electron microscopy (SEM). Plain PDMS surfaces were fabricated using soft lithography and then nanotexture was created by micro reactive ion etching (Micro-RIE) using three different recipes. The etching time and flow rate of etchants resulted in variations of texture roughness. Energy-dispersive x-ray spectroscopy (EDS) analyses showed no change in chemical composition of the substrates. The substrates were functionalized with probe molecules. A molecular dye was used that selectively bound to the molecules. The fluorescent micrographs were taken and the relative concentrations of surface grafted molecules were compared. Next, substrates were incubated with cells for 30 min at 37°C, washed, and cells were counted on different substrates. Number of captured cells was distinctly higher (P-value < 0.01) in nanotextured substrates. The optical and SEM imaging showed that cancer cells were not only flatter in their morphology but also made many more pseudopods on the nanotextured surfaces.

ATOMIC STRUCTURE DETERMINATION OF TWO NEW SUPERSTRUCTURES, $Ba_4Ti_5O_{10}$ AND $Ba_4Ti_4O_{11}$ IN EPITAXIAL BARIUM TITANATE NANODOMAINS USING NANO-BEAM ELECTRON DIFFRACTION AND HRTEM. JIE HE, JIECHAO JIANG* and EFSTATHIOS I. MELETIS, Department of Materials Science and Engineering, University of Texas at Arlington, Arlington, Texas.

We have fabricated epitaxial barium titanate thin films on MgO substrate using RF magnetron sputtering and studied their microstructure using high-resolution transmission electron microscopy (HRTEM). The thin films were found to be composed of two new superstructures, $Ba_4Ti_5O_{10}$ and $Ba_4Ti_4O_{11}$, formed as epitaxial nanodomain structures. Due to the nanometer scale size of the domains and the complexity of the structure in the film, the single crystal x-ray diffraction technique was inadequate to conduct the crystallographic structure determination of the two new superstructures. We used nano-beam electron diffraction to reconstruct the three-dimensional diffraction space and hence the symmetry of the new superstructures. Both $Ba_4Ti_5O_{10}$ and $Ba_4Ti_4O_{11}$ were found to be monoclinic structures with a space group of ***Cm*** (*b*-unique axis). $Ba_4Ti_5O_{10}$ has a lattice parameter a = 16.49 Å, b = 3.94 Å, c = 8.94 Å and β = 103°, while $Ba_4Ti_4O_{11}$ has a = 17.88 Å, b = 3.94 Å, c = 7.21 Å and β = 98°. Atomic structural models for the two new superstructures were established by reconstructing the HRTEM images taken from the three major axes and refined by matching the simulated

HRTEM images and calculated electron diffraction patterns with the experimental results. The two superstructures are epitaxially grown on MgO with their *b*-axis parallel to the growth direction.

This work was supported by the National Science Foundation under Awards NSF/CMMI 1335502 and NSF/CMMI NIRT-0709293.

CARBON-BASED NANOSTRUCTURES AND THEIR FUNCTIONALIZATION. OXANA V. KHARISSOVA*, Universidad Autónoma de Nuevo León, Monterrey, México. E-mail okhariss@mail.ru.

In this presentation, synthesis, characterization, and functionalization of various carbon nanostructures will be discussed. In particular, the attention is paid to carbon nanotubes, fullerenes, nanodiamonds, graphene and graphene oxide as objects to be functionalized. The functionalization has been carried out by a variety of methods using wet-chemistry methods, microwave and microwave-hydrothermal techniques. As an example, working with fulleropyrrolidines, the main objective of their study was to move the response range of C_{60} to UVA range. In case of carbon nanotubes and onions, the work is related to their synthesis using microwave heating of precursors and further functionalization with organic radicals to enhance their solubility in water and organic solvents. Less-common nanostructures as bamboo-like ones, nanobuds and nanodiamonds are also described, as well as related metal nanostructures. All obtained nanostructures have been studied by electron microscopy methods and Raman spectroscopy, among other techniques. Several useful applications have been obtained for functionalized carbon nanostructures.

ATOMIC SCALE STRUCTURAL AND CHEMICAL ANALYSIS OF ORDER/DISORDER γ'/γ INTERFACES IN SUPERALLOYS. S. MEHER*[1], S. NAG[1], R. E. A. WILLIAMS[2], P. NANDWANA[1], T. ROJHIRUNSAKOOL[1], H. L. FRASER[2] and R. BANERJEE[1], [1]Center for Advanced Research and Technology and Department of Materials Science and Engineering, University of North Texas, Denton, Texas, [2]Center for the Accelerated Maturation of Materials and Department of Materials Science and Engineering, The Ohio State University, Columbus, Ohio.

The interface between the ordered gamma prime precipitate and the disordered gamma matrix in Nickel and Cobalt-base superalloys plays a critical role in determining its high temperature microstructural stability, including the rate of precipitate coarsening and subsequently its mechanical properties. Using aberration-corrected high resolution scanning transmission electron microscopy (HRSTEM), the atomic scale structure and chemistry across the order/disorder interface in Ni-Al-Cr and Co-Al-W alloys have been determined. In a correlative study, combining orientation microscopy (OM) with atom probe tomography (APT), the true nature of these interfaces has been studied. These investigations clearly revealed the presence of two interface widths, of which one corresponds to the order-disorder transition, while the other corresponds to the compositional gradient across the interface. While the order/disorder interface is ~ 2-3 atomic layers thick in Co-base superalloy, the width of the compositional gradient across the same interface is ~12-14 atomic layers thick. A comparative study of interfaces in both Cobalt and Nickel-base g/g' superalloys have been carried out, which raises fundamental questions regarding the definition of these interfaces.

HIGH-RESOLUTION TEM OF HARD Zr–B–C–N FILMS. MINGHUI ZHANG*[1], JIECHAO JIANG[1], JAROSLAV VLČEK[2], PETR STEIDL[2], JIRI KOHOUT[2], RADOMIR CERSTVY[2], and EFSTATHIOS I. MELETIS[1], [1]Department of Materials Science and Engineering, University of Texas at Arlington, Texas, USA, and [2]Department of Physics, University of West Bohemia, Plzen, Czech Republic.

In this work, high-resolution transmission electron microscopy, electron diffraction, X-ray photoelectron spectroscopy and nano indentation were employed to systematically study the microstructures and mechanical properties of Zr-B-C-N films. Four films with a chemical composition of $Zr_{61}B_{27}C_6N_3$, $Zr_{41}B_{30}C_8N_{20}$, $Zr_{26}B_{26}C_6N_{42}$ and $Zr_{24}B_{19}C_6N_{49}$ were deposited by pulsed reactive magnetron sputtering in a nitrogen and argon gas mixture with a nitrogen fraction of 0%, 5%, 10% and 15% and 45% Zr fraction in the target erosion area.

The $Zr_{61}B_{27}C_6N_3$ film is a composite material involving an amorphous structure surrounding face-centered cubic (fcc) B-rich Zr(B,C,N) nano-columnar structures in which the B-rich Zr(B,C,N) crystalline has a [111] preferred orientation. The $Zr_{41}B_{30}C_8N_{20}$ film consists of nano-needle structures, which have a length of approximately 40 nm and a width of approximately 10 nm. This film was found to possess the highest hardness (36.4 GPa) and modulus (316.8 GPa). The nano-needles have an fcc structure and are composed of ZrN and/or Zr(B,N) nano-domain structures (~2 nm) that are semi-coherently joined by ZrN monolayer interfaces. The $Zr_{26}B_{26}C_6N_{42}$ film deposited with 10% N_2 fraction in the gas mixture is composed of refined crystalline ZrN nano-needle structures (~2 nm) embedded in an amorphous matrix. The $Zr_{24}B_{19}C_6N_{49}$ film has a pure amorphous-like structure. These results helped us develop a better understanding of the relationship between the microstructure and the mechanical properties of the Zr-B-C-N films. The highest hardness obtained for the $Zr_{41}B_{30}C_8N_{20}$ film is attributed to the particular microstructure that involves Hall-Petch strengthening effects from the ZrN and/or Zr(B,N) nanograins, and interface layer strengthening from the semi-coherent Zr-N monolayer boundary. The results showed that an amorphous structure could be introduced into the films by changing the N/Zr ratio via varying the N_2 fraction in the N_2/Ar gas mixture. Formation of such an amorphous structure has a negative impact on the mechanical properties of the films.

This work was supported by the National Science Foundation under Award NSF/CMMI 1335502.

MAPPING PLASMON MODES OF NANOAGGREGATES RESPONSIBLE FOR OBSERVATION OF SINGLE-MOLECULE SURFACE-ENHANCED RAMAN SCATTERING. NASRIN MIRSALEH-KOHAN, Texas Woman's University, Department of Chemistry and Biochemistry, Denton, Texas.

Electron-energy-loss spectroscopy (EELS) in a scanning transmission electron microscope (STEM) was utilized to

map plasmon modes of single molecule-active nanoparticles. It is well known that electromagnetic hot spots are responsible for single-molecule surface-enhanced Raman (SMSERS) activity, and that are located between the gaps of nanoparticles. However, our STEM/EELS plasmon maps did not show any direct signature of an electromagnetic hot spot in the gaps between the nanoparticles. Our electrodynamics simulations of both the near-electric field enhancement (hot spot) and EELS loss probability of the exact SMSERS-active nanoparticles were in good agreement with the experimental results. Our findings further suggest that the electromagnetic hot spot can be excited when the electron beam is positioned at the periphery of the nanoaggregate.

SILICON CARBIDE QUANTUM DOT SYNTHESIS AND THEIR SURFACE FUNCTIONALIZATION THROUGH COVALENT IMMOBILIZATION. MUNUVE MWANIA* and PETER KROLL, Department of Chemistry and Biochemistry, The University of Texas at Arlington, Arlington, Texas 76019-0065.

Silicon carbide (SiC) quantum dots (QDs) are eminent candidates for various applications ranging from nanoelectronics to energy conversion. Most of these undertakings require application-specific SiC QDs with tailor-made properties owing to their inert nature. QDs tend to form agglomerates and hence do not disperse well in aqueous and organic solvents, thus limiting their uses. In this talk we describe fabrication of SiC QDs (< 10 nm) from bulk powders (> 50 nm) and slurries through photo-assisted electrochemical corrosion. We show that the process (hence, the amount of QDs synthesized, as well as their size) can be controlled via regulating time and temperature, as confirmed by both high-resolution transmission electron microscopy and photoluminescence. HRTEM results reveal lattice fringes with a spacing of 0.25 nm, which corresponds to the *d* spacing of the (111) planes of bulk β-SiC. Further, to utilize the potential of these QDs for optical and sensing applications, a simple protocol for reliably tailoring their surfaces will be presented. We begin by covalently attaching primary amines as the base. The amine terminations are then converted to amine/carboxylate ($-NH_2/COOH^-$), amine/phosphonate ($-NH_2/PO_2CH_3$), and amine/thiolate ($-NH_2/SH$) functional groups. HRTEM (aggregation), fluoresceamine assay measurements and FTIR confirm the success of the surface modification schemes.

ALL-VANADIUM REDOX PHOTO-ELECTROCHEMICAL CELL: A NEW APPROACH TO STORE SOLAR ENERGY. ZI WEI*, DONG LIU, CHIAJEN HSU, and FUQIANG LIU, University of Texas at Arlington, Department of Materials Science and Engineering, Arlington, Texas.

As a promising alternative to photoproduction of hydrogen, highly efficient solar energy storage using electrochemically reversible redox couples, which were photo-catalyzed by semiconductors, has been demonstrated in this work. In the photoelectrochemical storage reactions, TiO_2-based photoanodes and Pt counter electrodes were coupled with two sets of reversible redox pairs, VO_2^+/VO^{2+} and V^{3+}/V^{2+} as the anolyte and catholyte, respectively. Carbon-coated TiO_2 photocatalysts with 10-minute heat-treatment in air displayed 60% improvement in photocurrent at 0.01M vanadium ions compared to bare TiO_2. However, the carbon was found to be not stable, possibly due to reactions between the surface functional groups and VO_2^+ species. On the other hand, bare TiO_2 showed better stability and enhanced photo response when concentration of vanadium ions was increased to 0.1M. Photoelectrochemical storage test using the bare TiO_2 without external bias showed a higher solar-to-fuel efficiency, with a Faradaic efficiency close to 100% without significant deactivation. Material characterization techniques, including Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and Raman Microscopy, have been employed to study the structure, composition and surface morphology of the photoanodes, which help to shed lights on the intricate structure-performance relationship in this all-vanadium redox photo-electrochemical storage cell.

MOLECULAR SURFACE TAILORING OF β-SiC QUANTUM DOTS. AGUIRRE-MEDEL SUSANA*, MUNUVE MWANIA and PETER KROLL, Department of Chemistry and Biochemistry, College of Science, The University of Texas at Arlington, Arlington, Texas 76019-0065.

Silicon carbide (SiC) is a chemically inert, stable and biocompatible material. Whereas bulk SiC is an indirect bandgap semiconductor without usable optical activity, at the nanoscale, the material reveals photoluminescence. This opens the perspective of using SiC quantum dots (QDs) for optoelectronic applications. Functionalization of these SiC quantum dots (QDs) brings about additional potential applications. However, most functionalization methods are expensive, complex, and time consuming. In this experiment, a strategy that yields functionalized SiC QDs in aqueous environment in just one day was demonstrated. Hydroxyl terminated β-SiC QDs were prepared through photo-assisted electrochemical corrosion of bulk slurries. The SiC QDs were then chemically modified to yield an amine surface group ($-NH_2$). Aminated SiC QDs underwent further modification to yield thiol groups (-SH) and carboxylic acid terminal groups (-COOH). Fluorescamine assay for primary amine groups confirmed success of amination while characterization of thiolated SiC QDs was attained through Ellmans assay. Further, taking advantage of Au affinity to sulfur, composite Au-SiC nanohybrids (NHs) were fabricated. Transmission electron microscopy (TEM) results show successful fabrication of the Au-SiC NHs. Au-SiC NHs have enhanced optical properties that could be used for photo-catalytic activity, energy harvesting, as well as for as environmental/analytical sensors.

FABRICATION AND CHARACTERIZATION OF THIN MEMBRANES AND DRILLING OF SOLID-STATE MICRO AND NANOPORES. WAQAS ALI[1,2,3], AZHAR ILYAS[1,2,3] and SAMIR M. IQBAL[1,2,3,4,5,*], [1]Nano-Bio Lab, [2]Department of Electrical Engineering, [3]Nanotechnology Research Center-Shimadzu Institute for Research Technologies, [4]Department of Bioengineering, [5]Joint Graduate Studies Committee of Bioengineering Program, University of Texas at Arlington and University of Texas Southwestern Medical Center at Dallas, University of Texas at

Arlington, Arlington, Texas 76019. *SMIQBAL@uta.edu

Solid-state micro and nanopore-based biosensors have enabled us to study cell behavior and electrically detect changes at the DNA and RNA levels. We present details of fabrication and characterization process of 200 nm thin silicon nitride membranes followed by pore openings. Etched membranes were characterized by confocal microscope and membrane morphology was studied using scanning electron microscope (SEM). SEM high vacuum (SE) and low vacuum (BSE) modes were used to take membrane images. Drilling of solid-state micropore and nanopore was done with focused ion beam (FIB) and transmission electron microscope (TEM), respectively. By using different settings of exposure time, milling voltage and milling current, micropores of sizes 1μm to 30μm were drilled with FIB whereas in TEM, nanopore dimension was primarily controlled by exposure time. The smallest pore that we were able to drill was 40 nm. Also we will discuss few shortcomings and limitations of the equipment used.

PREPARATION OF CARBON-BASED NANORODS STARTING FROM MWCNTS AND THEIR SELF-ASSEMBLING INTO PUZZLE-LIKE NANOSTRUCTURES. PATSY YESSENIA ARQUIETA GUILLÉN*, OXANA V. KHARISSOVA, and BORIS I. KHARISOV. Universidad Autónoma De Nuevo León, Monterrey, México. E-mail bkhariss@hotmail.com.

According to a classic definition, the self-assembling is the organization and reparation or fabrication of a system or structure without human intervention in the process. In this work, we obtained high-surface carbon nanorods by treating multi-wall carbon nanotubes (MWCNTs) with mixtures of mineral acids at temperatures close to the boiling point of water. As a result, less-common puzzle-like carbon nanostructures possessing high surface area were formed, which could be used as nanostructured sorbents. The formed products have been studied by EDX, TEM and SEM techniques. It was established that the formed nanorods tend to be united among themselves at an angle of 126° and width of 320 nm, thus forming previously unknown puzzle-like nanostructures. Due to internal porosity (pore size ranging from 21 up to 148 nm), their surface area is high, characteristic that makes them an excellent material for filtration and elimination of virus, bacteria and heavy metals from water.

CHARACTERIZATION OF CNTs FUNCTIONALIZATION WITH IRON NANOPARTICLES. OSWALDO S. ARRIETA CHAVEZ*, EDGAR DE CASAS ORTIZ, OXANA V. KHARISSOVA, and BORIS I. KHARISOV, Universidad Autónoma de Nuevo Leon, Mexico. E-mail bkhariss@hotmail.com.

Development of technologies for water desalination and purification is critical to meet the global challenges of insufficient water supply and inadequate sanitation, especially for point-of-use applications. In this work, we obtained composites of multi-wall carbon nanotubes (MWCNTs) with iron nanoparticles. As a result, carbon nanostructures possessing high surface area were formed, which could be used as nanostructured sorbents. The formed products have been studied by EDX, TEM and SEM techniques. We exploit this adsorption capacity in carbon nanotube-based membranes that can remove salt, as well as organic and metal contaminants. These carbon nanotube-based membranes may lead to next-generation rechargeable, point-of-use potable water purification appliances with superior desalination, disinfection and filtration properties.

MICROWAVE-ASSISTED SYNTHESIS AND PROPERTIES OF SUPERPARAMAGNETIC IRON NANOPARTICLES. KAIYUAN LUO*[1], GRANT C. BLEIER[2], ERIKA C. VREELAND[2], YUN-JU LEE[1], TODD C. MONSON[2], DALE L. HUBER[2], and JULIA W. P. HSU[1], [1]Department of Materials Science and Engineering, University of Texas at Dallas, Richardson, TX 75080, and [2]Center for Integrated Nanotechnologies, Sandia National Laboratories, Albuquerque, NM 87185.

For their high magnetic susceptibility without hysteresis, superparamagnetic nanoparticles are promising materials in electrical and biomedical applications, such as transformer and MRI contrast enhancement. We present the results of oleylamine-stabilized Fe nanoparticles with controlled size from 8.9 ± 1.0 nm to 14.5 ± 1.0 nm synthesized using microwave-assisted heating, which are characterized by dynamic light scattering (DLS) and low-voltage (5 kV, Delong LVEM5) transmission electron microscopy (TEM). High resolution TEM and selective area electron diffraction (SAED) using a 200 kV TEM (JEOL 2100F) show that these Fe nanoparticles are amorphous. The superparamagnetic properties of these nanoparticles are confirmed with both AC and DC magnetic measurements. In addition, larger size Fe nanoparticles, up to 20 nm, are prepared with methoxypolyethylene glycol amine as a surfactant. TEM images show that these nanoparticles are spherical with low size dispersity and self-assemble into chains and closed loops, suggesting strong magnetic interaction at room temperature. Due to the inexpensive precursor $Fe(CO)_5$, low reaction temperature (< 200° C), short reaction time (≤ 30 min), and good magnetic properties achieved in these experiments, microwave-assisted synthesis of superparamagnetic Fe nanoparticle is a promising approach for high-volume applications.

ELECTROLESS PLATING GROWTH OF Au-Pd CORE-SHELL NANOPARTICLES FOR ELECTROCATALYTIC STABILITY. SINA MOEENDARBARI*, CHIENWEN HUANG and YAOWU HAO, The University of Texas at Arlington, Department of Materials Science and Engineering, Arlington, Texas.

The electroless deposition of Pd on Cu-decorated porous hollow gold nanoparticles using a metal exchange reaction was investigated. The decoration process started from synthesizing porous hollow gold nanoparticles (PHAuNPs) using electrochemically evolved hydrogen nanobubbles as templates. The high concentration of hydrogen molecules in the bubble boundary reduced the Au^+ complex ion to form Au cluster. The metal Au gradually grew from clusters, particles to a porous network. Electroless copper deposition was conducted at room temperature. The electroless Cu plating experiment was conducted by delivering the 0.4 M copper sulfate solution into the alumina membrane channels (containing HauNPs) through the vacuum filtration process, and

then the membrane was immersed in the same bath for additional 20 minutes. The exchange reaction of Pd was carried out by immersing Cu-decorated PHAuNPs into an aqueous solution containing 2 mM palladium chloride ($PdCl_2$) for 30 minutes. HRTEM images of Pd-modified PHAuNPs clearly show the high-contrast Au core (due to its higher atomic number) and Pd shell of the Pd-modified PHAuNPs. The HRTEM image of Pd-modified demonstrates that PHAuNPs consist of different crystalline domains, each approximately 3 nm in diameter. The different orientation of lattice fringes in each crystalline domain can be highlighted in the HRTEM images. The polycrystalline nature of the Pd shell suggests that it grew via addition of small particles or clusters rather than by atomic addition. The PHAuNPs exhibit long-term durability and stability compared to commercial Pd black due to enhanced electronic coupling between the Au core and Pd shell.

STUDY OF MECHANICAL PROPERTIES OF THE KRAFT PAPER DOPED WITH NANOPARTICLES. BLANCA I. MONTES MEJIA*, EDGAR DE CASAS ORTIZ, OXANA V. KHARISSOVA, and BORIS I. KHARISOV, Universidad Autónoma de Nuevo Leon, Mexico. E-mail bkhariss@hotmail.com.

The paper is the most encountered and cheapest flexible organic material. Moreover, paper is a dielectric up to 3 GHz, with an electric permittivity of $\varepsilon_r \cong 3.3$ and losses expressed by $\tan\delta \cong 0.08$. In this work, multi-walled carbon nanotube (MWCNT) inks were used to print various patterns on plastic and KRAFT paper. We obtained KRAFT paper doped with multi-wall carbon nanotubes (MWCNTs), graphene and inorganic nanoparticles (SiO_2, TiO_2, ZrO_2). The formed composites have been studied by EDX, TEM and SEM techniques, as well as by Mullen test and retention. In conclusion, thus modified paper demonstrated excellent properties in comparison with standard papers.

SYNTHESIS OF CARBON NANOTUBES WITH HIGH SURFACE AREA FOR HYDROGEN STORAGE. BEATRIZ ORTEGA GARCÍA*[1,2], OXANA V. KHARISSOVA[2], ALFREDO AGUILAR E.[1] and MANUEL ROMÁN A.[1], [1]Centro de Investigación en Materiales Avanzados, Ciudad de Chihuahua, México. [2]Universidad Autónoma de Nuevo León, Monterrey, México. E-mail bkhariss@hotmail.com

In this work, different types of carbon nanotubes have been fabricated by the spray pyrolysis method from various hydrocarbon sources in quartz tube at 800°C. Pentane, hexane, heptane, cyclohexane, toluene and acrylonitrile were used as carbon source in the mixture with ferrocene as growth center for carbon nanotube formation. The obtained products have been studied by Field Emission Scanning Electron Microscopy (FESEM) showing distinct morphological characteristics. The surface analysis showed distinct capacity for hydrogen absorption for each type of samples. The samples prepared using acrylonitrile as a precursor showed major surface area in comparison with hydrocarbon sources. The formed products could be applied for creation of devices for selective absorption of hydrogen from gas mixtures.

FACILE SYNTHESIS OF SILVER DENDRITE CRYSTALS BY GALVANIC ELECTROLESS METHOD AND SENSING APPLICATION. RUIQIAN JIANG* and YAOWU HAO, University of Texas at Arlington, Department of Materials Science and Engineering, Arlington, Texas.

It has been demonstrated that Ag dendrite structures can be readily produced from a simple galvanic reaction between metal Cu and $AgNO_3$ solution. Here, we report a novel way to produce Ag dendrites and their electron microscopy characterization. We utilized Anodic Aluminum Oxide (AAO) membrane to separate reactant metal Cu and product Ag, producing completely free standing Ag dendrites. In this method, one side of AAO membrane side was sputter-deposited with 500 nm Cu layer through thermal evaporation. Then, a sealed cell was placed on the other side of the membrane and $AgNO_3$ solution was poured into the cell. Solution could only reach the Cu surface through channels inside the AAO membrane. To our surprise, Ag dendrites formed on the AAO surface without connect to the bottom Cu film. The size and amount of dendrites vary with different concentration of $AgNO_3$, reaction time and different sizes of channels inside AAO membrane. Prepared Ag dendrites can be easily separated from AAO top surface. The TEM characterization of such silver dendrites, including dark field view and selected area electron diffraction patterns, reveals that each dendrite is one single crystal. We also characterized the dendrites with X-ray powder diffraction, scanning electron microscope, and energy-dispersive X-ray spectroscopy. These results raised many interesting questions about the formation mechanisms of Ag dendrite. The fabricated dendrites, due to their large surface area and low conductivity of Ag, have found applications in manufacturing high efficient electrodes for the study of signal transmitting in neurons.

CHARACTERIZATION OF ORGANIC-INORGANIC HYBRID SCINTILLATING MATERIALS WITH TEM. SUNIL SAHI* and WEI CHEN, Department of Physics, University of Texas at Arlington, Arlington, Texas.

Inorganic single crystals and organic scintillators (plastic or liquid) are the two widely used materials for scintillation applications. The inorganic single crystals has high stopping power due to higher density and hence better efficiency. However, these single crystals are difficult to synthesize and are very expensive. Organic scintillators have poor stopping power because of low Z-value, which limits their applications for gamma spectroscopy. Organic-inorganic hybrid materials, which combined the properties of inorganic and organic materials, could be a possible solution to these drawbacks. We have synthesized the nanocrystals of inorganic materials and embedded them into a polymer matrix. We have characterized the nanocrystals phase using X-ray diffraction (XRD). Transmission Electron Microscope (TEM) was used to determine the size of the nanocrystals. The size of the nanocrystals is important because large size can cause light scattering and hence decrease the efficiency of the hybrid scintillator. TEM shows the sizes of the synthesized nanocrystals are less than 20 nm. The optical properties of the hybrid materials were measured. The synthesized hybrid materials showed enhanced luminescence properties under ultra-violet (UV) radiation and X-ray excitation and could be promising materials for high-energy (X-ray or gamma ray) detection.

BIOLOGICAL SCIENCES
SPRING 2014

NOVEL INTERACTION OF CHROMATIN COMPACTING PROTEINS HDAC8 AND LINKER HISTONE H1. RHIANNON.W. GONZALEZ*, M. RAYA, J. FYEN and M. BERGEL, Department of Biology, Texas Woman's University, Denton, Texas 76204.

Chromatin folding and unfolding is regulated by chromatin binding proteins and epigenetic modifications of core and linker histones. HDACs and linker histones have traditionally been implicated in compaction of chromatin. Linker histone H1 is known to compact chromatin by binding nucleosome core particles at the diad axis and at the DNA entry-exit site. HDACs compact chromatin through removal of acetyl groups from core histones. Co-immunoprecipitation, *in vitro* pull-down and electrophoretic mobility shift assays showed a direct interaction between HDAC8 and linker histone H1.3. Confocal microscopy studies demonstrated cellular colocalization of H1.3 and HDAC8 in MCF7 cells. Furthermore, confocal analysis revealed a colocalization of HDAC8 and H1.3 to vesicles. HDAC8 has further been characterized to Rab6 and Rab7 positive vesicles, thus indicating that the HDAC8-H1.3 complex could be associated with retrograde Golgi to ER transport, anterograde Golgi to plasma membrane transport or late endosome to lysosome transport. It has been reported that HDAC8 is overexpressed in some cancers in contrast to normal tissue where there was lower or no HDAC8 expression at all. The described finding of the HDAC8 and H1.3 complex gives new insight into both nontraditional functions of these proteins and new promising targets for anticancer therapies.

HMGN1 PROTEIN INVOLVEMENT IN DNA REPAIR FOLLOWING UV-IRRADIATION. LATONDRA LAWRENCE*[1], MANGALAM SUBRAMANIAN[2], KATHRYN HOKAMP[3], and MICHAEL BERGEL[1], [1]Department of Biology, Texas Woman's University, Denton, Texas, 76204, [2]Amway, Ada, Michigan, 49355, and [3]Rice University, Houston, Texas, 77251.

UV light causes DNA damage which may lead to inflammation, skin aging, and cancer. One of the major chromatin remodeling activites during DNA repair is the dynamic unfolding and folding of chromatin. In particular, the unfolding of chromatin following DNA damage enables the accessibility of the repair machinery to the damaged sites. High Mobility Group Nucleosomal binding proteins (HMGNs) serve as architectural proteins that modify the chromatin by transiently binding to the nucleosomal core particles and consequently regulating transcription and DNA repair. HMGN1/N2 may play a role in DNA repair by recruitment of repair modulators such as HATs and HDACs to the damage site or to the chromatin globally. Alternatively, HMGN1/N2 may modulate the HATs and HDACs activity by interacting with the core histones, and without participating in HAT/HDACs recruitment to chromatin. Here we show that overexpressing HMGN1 leads to a significantly higher cell survival and an enhanced DNA repair rate following UV-irradiation. HMGN1 overexpressing cells showed increased core histone acetylation levels but returned to steady-state levels at a rate comparable with the normal HeLa cells. Coimmunoprecipitation results supported the hypothesis that HMGN1 recruits HATs and HDACs to the chromatin in a specific sequence after UV-irradiation. Using a local UV-irradiation procedure, we have shown that HMGN1 displays a loose colocalization to the DNA damaged sites early after UV-irradiation but a high colocalization late in the DNA repair process. Thus, confocal and fluorescence microscopy further indicated that HMGNs are recruited to the chromatin at a specific time and location following UV-irradiation.

TESTOSTERONE MAY SUSTAIN SPERMATOGENESIS BY REGULATING PROTEINS OF THE BLOOD-TESTIS BARRIER TIGHT JUNCTIONAL-COMPLEXES. SAMUEL SANG*, BARKHA SINGHAL, ARPITA TALAPATRA, DIBYENDU DUTTA, IN PARK and NATHANIEL MILLS, Texas Woman's University, Department of Biology, Denton, Texas.

Testosterone (T) acting through the androgen receptor (AR) is needed for spermatogenesis. Testosterone regulates genes that are needed for male fertility and virility and is thought to act in Sertoli and peritubular cells to create an enabling environment for normal progression of germ cells during spermatogenesis. Sertoli cell tight junctions (TJ) are essential components of blood testes barrier (BTB) that regulates movement of substances into and out of the seminiferous epithelium. This study investigated T loss and short term T replacement on TJ function and expression of TJ proteins. We used ethylene dimethane sulfonate (EDS) to selectively ablate Leydig cells - the source of androgen in rat testis. EDS treatments reduced testicular weights and serum and testicular androgen. Several days post-EDS, changes in gene expression of TJ proteins with and without testosterone replacement were examined. Expressed genes for TJ proteins were assessed by real-time PCR and the proteins were localized by immunohistochemistry, whereas TJ integrity was assessed with a biotin permeation tracer. Using RT-qPCR, we examined the tissue mRNA levels for tricellulin (*Marvld2, Tric*), claudin 3 (*Cldn3*), claudin 11and aquaporin-9 (*Aqp9*), all – major anchoring junction (AJ) and TJ proteins. In addition, mRNA levels for testin (*Testin*), a protein associated with ectoplasmic specialization (a testis specific anchoring junction) was measured. A decreased expression of *Marvld2* and *Cldn3* and an increased expression of *testin* and *Aqp9* occurred in the absence of testosterone. With EDS treatment plus T replacement, expression values for these genes returned to near control levels. In contrast to controls, EDS induced seminiferous tubule BTB permeability to biotin and loss of tubule lumen. Alternately, EDS plus maintenance of T via exogenous testosterone retained BTB integrity. This suggests that testosterone may control paracellular movement of water, electrolytes, nutrients, and biomolecules by maintaining the BTB and lumen flow. As well, genes that modulate transcellular water, glycerol, electrolytes and other small solutes appear to be regulated by T. Thus, T is important for Sertoli cell maintenance of the adluminal compartment environment by providing needed components and stability for developing germ cells in seminiferous tubules.

RESPONSE OF *CAENORHABDITIS SPECIES 9* STRAIN EG5268 TO OXIDATIVE STRESS. MASON YOCKEY*, PHIL HARTMAN, and ERNEST COUCH, Texas Christian University, Biology Department, Fort Worth, Texas.

Caenorhabditis elegans is a popular laboratory model organism. This non-parasitic nematode is small and simple, but genetically similar to larger and more complex organisms, including humans. Thus, experiments significant to human life can be performed on large numbers of *C. elegans* within an economical amount of time and space. There are many other nematode species in the genus *Caenorhabditis*, with similarities and differences to *C. elegans*, which have been used as model systems. However, *C. elegans* is the best known model organism for molecular and developmental biology studies. EG5268 is a recently isolated strain of *Caenorhabditis species 9*, which does not yet have a taxonomic name. We studied this animal under conditions of oxygen stress, comparing its responses to those of *Caenorhabditis briggsae*, and to *C. elegans* strain PB3493, a nuclear-mitochondrial hybrid strain created from EG5268 and *C. briggsae* strain AF16. Our hypothesis was that the hybrid strain PB3493 would display diminished fitness relative to the wild type parent strains. Our results were inconclusive and could not support the hypothesis at this stage of the study. EG5268 was imaged under the scanning electron microscope. As *C. species 9* is gonochoristic, as opposed to *C. elegans* and *C. briggsae*, which are hermaphroditic, EG5268 animals display different morphology based on gender. Oxygen stress negatively impacted the animals' growth and reproduction, and appeared to have a small positive impact on their lifespan, in a possible hormetic effect.

FLOWER STRUCTURE AND REPRODUCTIVE ECOLOGY OF SUMMER SNAPDRAGON, *ANGELONIA ANGUSTIFOLIA* (*PLANTAGINACEAE*). BRENDA BARRON and CAMELIA MAIER, Texas Woman's University, Department of Biology, Denton, Texas 76204-5799.

The Summer Snapdragon, *Angelonia angustifolia* (*Plantaginaceae*) native to Mexico and Southern United States was introduced in horticulture worldwide due to its beautiful floral clusters. This species is tolerant to high temperatures and drought and is a very suitable ornamental plant for Texas. The flowers of *A. angustifolia* produce oil instead of nectar as reward for pollinators and therefore are pollinated by oil-collecting bees. The purpose of this research was to study the reproductive ecology of *A. angustifolia* in the North Texas area. Scanning electron microscopy was employed to characterize the anatomical structures of the flowers at different developmental stages. Two different fixation methods, methanol and glutaraldehyde-osmium tetroxide, were used in order to identify the best fixation for the floral specimens. The flower is irregular and has a complicated structure with five petals fused together at the base and forming an upper lip and a larger lower lip with a platform for pollinators' landing. The oil is produced by glandular hairs in two specialized pockets of the petal tube called elaiophores in an arrangement unique to oil-producing flowers. Each oil trichome has a head of 8-10 elongated cells on a three-cell stalk. The disposition of the elaiophores is restrictive to the majority of insects and only specialized oil-collecting bees can reach them and thus cross-pollinate the flower. Each fixation method provided best results for different floral parts under study. The oil trichomes were better preserved with the glutaraldehyde-osmium tetroxide fixation, while petal cells showed less to no shrinkage with the methanol fixation. Further research will focus on identifying pollinators in the North Texas area and studying their mutualistic relationship with *A. angustifolia*. Understanding the reproductive ecology of Summer Snapdragon may serve as a tool for gardeners for obtaining own seeds (which are expensive if bought from nurseries). Besides the practical applications, this study will contribute to the ecological, taxonomical, and evolutionary knowledge about this species and oil flower pollination in general.

Supported by TWU Undergraduate research Microgrant Program (URMP).

STOMATAL SEXUAL DIMPORPHISM IN OSAGE-ORANGE, *MACLURA POMIFERA* (*MORACEAE*). SAMANTHA FOLEY* and CAMELIA MAIER, Texas Woman's University, Department of Biology, Denton, Texas 76204-5799.

Osage-Orange, *Maclura pomifera* (*Moraceae*) is a dioecious native species to North America, being represented by male and female individual trees. Although trees look similar, there are certain traits of sexual dimorphism that differentiate male and female individuals of this species. The purpose of this research was to study the sexual dimorphism of *M. pomifera* at the level of stomata. Leaves were collected from at least three different male and female trees. Specimens were either air-dried or fixed with glutaraldehyde-osmium tetroxide or FAA for observations with a benchtop Hitachi T-1000 SEM. The results obtained with the fixed specimens were compared to the air-dried ones. Measurements of the guard cells and stomatal pores were taken at 1000X magnification and stomata were counted per microscopic screen at 300X magnification. Different average stomatal measurement values were obtained for the fixed specimens compared to the air-dried ones, most likely because of significant cellular shrinkage in the air-dried specimens. However, the stomatal measurements and counts were not significantly different between male and female in both air-dried and fixed leaf specimens. Although it seems that there is no sexual dimorphism at the level of stomata abundance and size in *M. pomifera*, we consider that the results of this small study are inconclusive. In future studies, more *M. pomifera* trees, as well as other *Moraceae* species will be used and fixation with gluteraldehyde-osmium tetroxide, which gave the best leaf specimen preservation, will be employed. This study will enhance our knowledge of the morpho-anatomical and physiological sexual dimorphic traits of *M. pomifera* and other related dioecious species.

ANALYSIS OF AEROALLERGEN USING MICROSCOPY: GLOBAL WARMING, INCREASED ALLERGIES AND AHPCO TECHNOLOGY. GABRRIEL MIRANDA*[1], DANIUS BOUYI[1], JEFF BENNERT[2] AND NABARUN GHOSH[1]. [1]Department of Life, Earth and Environmental Sciences, West Texas A&M University, Canyon, Texas 79015 and [2]Air Oasis, Research and Development, Amarillo, Texas 79118.

Allergies are caused by a hypersensitive reaction of the human body's immune system to the allergen. Global warming exerts substantial effect on flora and fauna. Increasing greenhouse gases cause accelerated pollinosis and fungal spore production, two major aeroallergens for asthma and allergies. We have analyzed the 14-year aeroallergen data of the Texas Panhandle using a Burkard Volumetric Spore Trap (UK) and digital microscopy. Exposed Melinex tapes were stained and observed under a BX-40 Olympus microscope. Most frequent fungal spores included *Alternaria*, *Cladosporium*, *Curvularia*, *Pithomyces* and many smut teliospores. Pollen grains were from grasses (*Poacee*), Ragweed *Ambrosia artemisiifolia*), Redroot pigweed *(Amaranthus retroflexus)*, Lamb's quarters (*Chenopodium album)*, and pines (*Pinus* spp.). The 14-year aeroallergen data revealed a gradual shift in aeroallergen index as well anomalous aeroallergen indices, which correlated with early flowering.

The second objective of the study was to assess the efficiency of the Xtreme 3000 and InductACT air purifiers that use Advanced Hydrated Photocatalytic Oxidation (AHPCO) technology in reducing aeroallergens. These air purifiers were evaluated in the microbiology and mycology room of BSA Hospital laboratory (Amarillo, Texas) in terms of the net reduction of bacteria in a negative pressure laboratory and the specific effect on isolates identified to be methicillin resistant *Staphylococcus aureus* (MRSA). Bacteria isolated from the room air were Gram-positive bacilli such as *Bacillus* sp. and *Corynebacterium* sp. (diphtheroids), coagulase-negative *Staphylococcu*s sp., *Micrococcus* sp., and encapsulated Gram-negative bacilli. We recorded an average of 68.5% reduction of bacterial population on the TSA plates when using the Air Oasis purifiers in the rooms. The AHPCO nanotechnology also is being used to develop devices to ensure the safety in food processing chambers and make the surface of the mobile phone germ-free by reducing aeroallergens, such as pollen, bacteria, fungal spores and hyphae, dust particles, fibers and animal dander.

MICROSCOPIC EXAMINATION OF CHROMOSOMAL COMPLEMENTS OF TWO PLANT SPECIES. BRIAN SCASTA*, MICHELE VELOZ and NABARUN GHOSH, Department of Life, Earth and Environmental Sciences, West Texas A&M University, Canyon, Texas 79015.

The metaphase chromosomes in the root tips of Onion, *Allium cepa* (*Amaryllidaceae*) and Yellow salsify, *Tragopogon dubius* (*Asteraceae*) were examined microscopically for the purpose of karyotyping. The roots obtained from germinated seeds were pre-treated with para-Dichlorobenzene (pDB) and Esculin for 3 hours followed by fixation with 1:3 acetic acid-ethanol overnight. Squashed root tips were stained with 2% aceto-orcein:1N HCl solution and observed under light microscopes. Fluorescence *In situ* Hybridization (FISH) with 18S rDNA fluoriescein-labelled probe (template: 1.3 kbp clone from *T. dubius*) was performed with root tips of *T. dubius* following standard protocols. The root tips were digested with an enzyme mix consisting of Pectolyase Y23 and Cellulase in a citric buffer. Cell suspensions were examined with a phase contrast microscope and slides with good chromosome spreads were selected for FISH. DNA was stained with DAPI and the slides were observed with DM-750 Leica and BX-51 Olympus microscopes equipped with DAPI, FITC, TRITC fluorescent filters, a mercury lamp source, and an Olympus DP-70 Digital camera attached to a computer with Image-Pro 6.0 software. We determined the homologous chromosome pairs of *T. dubius* and *A. cepa* and build karyotypes for both species. *A. cepa* showed 2n=16 homologous chromosomes ranging from metacentric to submetacentric. *T. dubius* showed 2n=12 chromosomes ranging from metacentric, sub-metacentric and telocentric chromosomes with 2 satellites on chromosome A. The patterns of fluorescent bands revealed by FISH methodology facilitated the characterization and pairing of the homologous chromosomes in constructing the karyotypes of the species under study.

NEURONAL UPTAKE OF TUNABLE NANOCARRIERS AND THEIR EFFECT ON AXON GROWTH. SUMOD SEBASTIAN*[1], THOMAS MCALLISTER[2], SANTANEEL GHOSH[2] and DIANNA HYNDS[1], [1]Department of Biology, Texas Woman's University, Denton, TX 76204 and [2]Department of Physics and Engineering Physics, Southeast Missouri State University, Cape Girardeau, MO 63701.

Development of novel nanocarriers to encourage axon regeneration and guidance is promising for functional recovery from CNS injury and damage. Biocompatible nanocarriers that are capable of crossing the blood brain barrier can be used to target therapeutics to particular subsets of neurons. Difference in surface functionalization will be a key factor in targeting nanocarriers to different subcellular destinations. In the present study, to learn the neuronal uptake mechanism of nanocarriers, B35 and PC12 cells were treated with surface functionalized nanospheres (SFNPs). The nanospheres were surface functionalized with fluorescently tagged -COOH (~750 nm and ~144 nm) and $–NH_2$ (~150 nm) groups. Treatment with both –COOH and –NH2 SFNPs resulted in their uptake into both the cytoplasm and nucleus of B35 cells. To determine caveolin-mediated endocytosis of SFNPs, B35 and PC12 cells were treated with fluorescent markers and 3ul of SFNPs for different time intervals. Also, inhibitors of caveolin-mediated endocytic pathway were be used to confirm their internalization mechanism. In future, drug loaded nanospheres will be used to asses uptake, drug transport and axonal guidance in mouse corticospinal tract neurons.

Supported by TWU Research Enhancement Program.

ROLE OF TNFα/TNFα RECEPTORS IN ADULT RAT TESTIS AFTER ETHYLENE DIMETHANE SULFONATE TREATMENT. BARKHA SINGHAL*, IN PARK, SAMUEL SANG, ARPITA TALAPATRA, DIBYENDU DUTTA and NATHANIEL MILLS, Department of Biology, Texas Woman's University, Denton, Texas 76204-5799.

Tumor necrosis factor (TNF-α) is a multifunctional cytokine secreted in mammalian testis by germ cells, Sertoli cells and to some extent by macrophages. However, TNF-α receptors are largely confined to Sertoli cells. TNF-α regulates different cellular processes pertinent to spermatogenesis including steroidogenesis, germ cell apoptosis, growth hormone function and inflammation. The Fas/FasL apoptotic pathway is the current model for depletion of Leydig cells with ethylene dimethane sulfonate (EDS) treated adult rat testis. We are investigating a potential role of TNF-α in EDS Leydig cell depletion as well as other tissue correlates. Using RT- and q-PCR, we found that the mRNA expression of Leydig cell markers, *Lhr* and *Insl-3*, declined by more than 85% and *3β-HSD* declined by 97% when compared to control at 24 hr post-EDS treatment. Using TUNEL, a DNA fragmentation detection assay, we observed a time dependent loss of Leydig cells by apoptosis. Genes associated with inflammation, (1) *TNF-α* increased modestly, and (2) *IL-1β* increased 3 fold, at 24 hr post-EDS. A three-fold increase in TNF-α receptor superfamily member 1A mRNA (*Tnfrsf1a/ CD120a*) was found. However, no change was observed in tumor necrosis factor receptor superfamily member 1B mRNA (*Tnfrsf1b/CD120b*) at 24 hr post-treatment. The mRNA of the two TNF-α receptors has a differential expression, suggesting their presence in different cell types. Using ELISA assay, TNF-α protein expression in the testicular tissue increased at 24 hr post-EDS. Thus, the changes in TNF-α/ TNF-α receptor activity at 6, 15 and 24 hr post-EDS treatment and the high percentage loss of Leydig cell at these time points may imply the involvement of TNF-α activity in Leydig cell apoptosis following EDS. We surmise that a better correlation between Leydig cell loss post-EDS and TNF-α activity may be found if the Leydig cell loss can be prevented by using TNF-α antagonists. Future work will focus on the localization of TNF-α receptors using immunohistochemistry and on preventing Leydig cell loss by using TNF-α antagonists.

[Research Support: Research Enhancement Program, TWU and Research Focus Grant, TWU Collage of Arts and Sciences]

REPRODUCTIVE ECOLOGY OF THE TEXAS NATIVE TROUT LILY, *ERYTHRONIUM ALBIDUM* (*LILIACEAE*). MASHAER SUNBUL*, JULIA POULOSE*, MARCY HARSARAN* and CAMELIA MAIER, Department of Biology, Texas Woman's University, Denton, Texas 76204-5799.

Trout lily, *Erythronium albidum* (*Liliaceae*) is a rare native plant species found in moist wooded areas of Texas. Plants need seven years to reach maturity, and are visible above ground for only 1-2 months (February-March) yearly, making it hard to study them. Trout lilies live in large populations and reproduce both sexually, through seeds, and asexually, through underground stolons. Phenotypic variation was observed in a population of Trout lilies located at Spring Creek Preserve in Garland, Texas. The goal of this project was to study the reproductive ecology and the phenotypic variation within the above-mentioned population by employing microcopy techniques and field observations. Morpho-anatomical characteristics of leaves, flowers, and seeds were compared between two phenotypic subgroups inside the *E. albidum* population, namely plants with slightly colored flowers (CF group) *vs.* plants with white flowers (WF group). Plants in the CF group had a significantly higher number of stomata per microscopic screen than plants in the WF group. However, the length of stomata was significantly higher for the WF plant group. The diameter of the pollen from plants in both groups was similar. Each seed possessed an elaiosome, tissue rich in lipids and proteins, which is known to attract ants for dispersal. Three species of ants associated with the population of *E. albidum* under study were visualized with SEM and only two ant species were identified as Acrobat Ants, *Crematogaster* spp., and Little Black Ants, *Monomorium minimum*. None of the ant species were observed dispersing Trout lily seeds. In the future, the Amplified Length Polymorphism (AFLP) technique will be used to study the genetic variability of the Trout lily population to explain the observed phenotypic variation. This study contributes a better understanding of the life history of *E. albidum,* which will help with conservation and restoration efforts of this rare plant species.

TESTOSTERONE MODULATES GERM CELL NUMBERS THROUGH APOPTOSIS INVOLVING THE Bcl2 GENE FAMILY IN RAT TESTES. ARPITA TALAPATRA*, SAMUEL SANG, BARKHA SINGHAL, DIBYENDU DUTTA and NATHANIEL MILLS, Department of Biology, Texas Woman's University, Denton, Texas.

Apoptosis, a process that leads to the cell death, needs to be very closely controlled. Major regulators of apoptosis signaling are: (1) recognition of extracellular signals and/or (2) intracellular damage and either regulation pathway will lead to event cascades culminating in cell death. In spermatogenesis, apoptosis is characterized by shrinkage of total cell volume, increase of cell densities and compaction of cell organelles. Apoptotic activity is also a very important regulatory process during sperm development.

In our study, male rats were treated with ethane dimethane sulfonate (EDS) (75 mg/kg body weight) to selectively eliminate mature Leydig cells and thereby ablating testosterone. At 7-days post-EDS, tissues were collected, fixed and sectioned for TUNEL assay and extracted for total RNA analysis followed by RT-qPCR gene expression quantification. Separate treatment groups received exogenous testosterone for either supplementation or replacement following EDS. Significant germ cell apoptosis in EDS-treated rats was demonstrated by the TUNEL assay and testosterone replacement prevented the germ cell apoptosis. Levels of *Tnp1* were assessed to evaluate round spermatid viability. The levels of both pro- and anti-apoptotic genes of the Bcl2 family were evaluated and a significant increase in expression of pro-apoptotic genes (*Bak-1, Bad, Bax, Bik, Bmf* and *Bok)* and anti-apoptotic genes (*BclW*, *Bcl2, Bcl2L10, BclXL* and *Mcl1*) in testes of EDS-treated rat was observed. Further, an increase in cellular levels of *Fas* and *FasL* and variability in caspase levels were found. We suggest that the Bcl2 family of genes along with major death receptors may regulate apoptosis modulated by testosterone.

This research was supported by REP Grant, Research Focus Grant and the Department of Biology, TWU.

SURFACE FUNCTIONALIZED NANOPARTICLES AND THEIR ENDOCYTOSIS MECHANISM IN NEURONAL CELLS. REMYA A. VEETTIL*[1], THOMAS MCALLISTER[2], SANTANEEL GHOSH[2] and DIANNA HYNDS[1], [1]Department of Biology, Texas Woman's University, Denton, TX 76204, [2]Department of Physics and Engineering Physics, Southeast Missouri State University, Cape Girardeau, MO 63701.

Traumatic injury to the central nervous system causes acute neuronal death and surviving injured neurons do not readily regenerate their axons, leading to permanent functional loss. Nanomaterial-based drug delivery systems provide potential for encouraging axon regrowth from specific neurons. In the present study, we analyze the mechanisms of cellular uptake of surface functionalized nanospheres. We used -COOH and $-NH_2$ surface functionalized nanospheres to study the mechanism of cellular uptake in B35 and PC12 cells. The highest dose of –COOH surface functionalized nanospheres showed more perinuclear concentration, whereas –NH2 surface functionalized nanospheres showed both nuclear and perinuclear uptake in both B35 and PC12 cells. Also, we found that the –NH2 surface functionalized nanospheres were endocytosed through clathrin mediated endocytosis in PC12 cells. In future, we will also investigate the mechanisms of cellular uptake of surface functionalized nanospheres in corticospinal tract neurons. Together, these results will test the feasibility of functionalized nanocarriers for targeted drug delivery to encourage axon regeneration following nervous system damage.

Supported by TWU Research Enhancement Program.

CALCIUM CARBONATE DEPOSITION IN IDIOBLASTS OF WHITE MULBERRY, *MORUS ALBA* (*MORACEAE*). NASMITA HIRACHAN AND CAMELIA MAIER*, Department of Biology, Texas Woman's University, Denton, Texas 76204-5799.

Mineral deposits of calcium, silica, and other minerals are common in the plant kingdom but not much is known about their deposition and functions. White mulberry, *Morus alba* (*Moraceae*) tissues contain calcium oxalate crystals as sand, prismatic and druse formations, as well as amorphous calcium carbonate depositions known as cystoliths, which form in specialized cells called idioblasts. In the leaves, the calcium oxalate crystals are found in the mesophyll and cells around the veins. Cystoliths are formed only in idioblasts of the upper epidermis but are found among the palisade mesophyll cells due to the downward enlargement of the idioblasts during the formation of the cystoliths. In this study, a special procedure was used to trace the deposition of calcium carbonate into cystoliths. Fully expanded leaves were collected and specimens were incubated in 0.5% $AgNO_3$ for 2 hrs before fixation in 2% gluteraldehyde in cacodylate buffer at 4°C overnight. After dehydration in series of ethanol, specimens were treated with propylene oxide, infiltrated and embedded. Some thick sections were visualized with a Hitachi T-1000 SEM, others were stained with methylene blue-azure B and basic fuchsin and observed with a light microscope. Under SEM, white particulates representing silver-stained calcium carbonate aggregates were seen on cystoliths, membranes inside the idioblasts, and in the intercellular spaces and vacuoles of the cells surrounding the idioblasts. Light microscopy detected black particulates in the same tissue areas. Neighboring cystoliths were also noticed in the specimens stained for light microscopy observations. The content of the idioblasts appeared blue in general, most likely due to methylene blue staining of the carboxylic acid in the idioblasts, as well as of the cellulosic walls involved in the formation of cystoliths. Further studies on the calcium deposition in mulberry cystoliths will employ TEM. The $AgNO_3$ treatment of the specimens combined with SEM observation of thick sections proved to be very useful in detecting calcium carbonate in leaf tissues.

GEOLOGY
SPRING 2014

EFFECTS OF SHALE ON CRINOID PRESERVATION. BROOKE LONG* and ARTHUR BUSBEY, Texas Christian University, School of Geology, Energy, and the Environment, Fort Worth, Texas.

Crinoid columnals, collected from the Pennsylvanian Period's Wolf Mountain Shale Member of the Graford Formation in Bridgeport, Texas, were studied under SEM. Crinoids are a class of echinoderms commonly known as sea-lilies. Most extinct forms were anchored to the seafloor by their stem. The stem is made of small disk-like structures called columnals composed of a magnesium calcite mesh-like skeleton called a stereom. These crinoids, after death, were quickly covered in mud on a shallow sea floor and fossilized in a mudstone. As the columnals were encased in shale, we studied the relationship of the clay minerals to the columnal in an attempt to see if they influenced the recrystallization of the stereom. The SEM revealed the effects the mud had in preserving the outer structure of the crinoid columnals. The columnals preserved the outer macroscopic appearance of the skeletal elements, but the SEM images showed that the stereom structure had been lost to recrystallization during diagenesis. A crude pattern of denser calcite may reflect the original skeleton and smaller calcite crystals may represent the authegenic growth of calcite into the open spaces of the mesh. In no place did we see clay flakes embedded within the smaller crystallized areas that may represent the original open areas. Thus a crude model of recrystallization diagenesis is proposed. Dewatering of the shale during compaction would have provided abundant fluids for dissolution and recrystallization of calcite. Absence of clay minerals in the former pore spaces indicates that the recrystallization occurred early in diagenesis before there was sufficient pressure to force the smaller clay flakes into the stereom open spaces.

EDUCATION
SPRING 2014

DISCOVERING MICROSCOPIC AQUATIC LIFE BY ELEMENTARY STUDENTS. BRENDA DELGADO*, CINDY ESTRADA, JOEL BABITZKE, and NABARUN GHOSH, Department of Life, Earth and Environmental Sciences, West Texas A&M University, Canyon, USA.

We have been working for a decade on an outreach education project, which engages students at Puckett Elementary and Oak Dale Elementary schools in Amarillo, Texas. The topic of the educational project is aquatic ecology. Students collected specimens with supplied plankton nets from ponds and creeks and observed them with a Digiscope connected to a laptop. Collected samples were placed in labeled vials for further observation, identification, and analysis. Prepared slides were observed with an Olympus BX40 microscope equipped with FITC, TRITC filters, and an Olympus DP-70 digital camera connected to the computer with Image Pro 6.0 software. The micrographs were captured with DP Manager and were analyzed using the Image Pro 6.0 software. Twenty-five organisms were viewed and photographed using bright field setting. The micro-arthropods were viewed, identified and photographed with an Olympus SZ-40 stereomicroscope attached to a DVC camera. We observed *Spirogyra, Cladophora, Ulothrix, Oscillatoria, Anabaena,* and pinnate diatoms in the collected water samples. Besides a rich planktonic diversity, common freshwater insects such as dragonflies, damselflies (Odonata), stoneflies (Plecoptera), caddisflies (Trichoptera) and mayflies (Ephemeroptera) were found as well. Comparisons were made on the biodiversity and abundance of different species at three locations along a stream, namely riffle, run and pool. Observing the diversity of aquatic organisms in their natural surroundings rewarded the students with a memorable experience they could share with each other throughout the school year, and provided the elementary teacher a foundation to expand on biological concepts and a means to attract interested students to biology. This on-going project also enhances our knowledge of the biodiversity in the local streams, ponds, and the waterfall in Ceta Canyon since there are very few ecological report on local biodiversity.

DEVELOPING LESSONS PLANS AND RUBRICS FOR BIOLOGY CLASSES USING DIGITAL MICROSCOPY. CALLIE SIMS*, BRENDA DELGADO, CINDY ESTRADA* and NABARUN GHOSH, Department of Life, Earth and Environmental Sciences. West Texas A&M University, Canyon, Texas, 79015.

Advancement of techniques and refinement of digital software applied to microscopies have opened new opportunities for building lesson plans by teachers. Digital microscopy and the software for image analysis are well received by students and raise their interest in studying biology. More educators choose to use the digital technology as a tool to better engage students in the classrooms and thus enhance their performance. Rubrics have become popular with teachers as a means of communicating expectations for assignments, providing focused feedback on work in progress, and grading final products. For this project we used a DM 750 LEICA microscope equipped with a digital camera, LAS-EZ software, and a Digiscope attached to a PC equipped with Motic Educator software. Digital images were captured using the Motic Image 2.0 Plus software and were opened in Motic Educator to perform microscopic measurements. Lesson plans were designed following the TEKS guidelines on compound microscope and microscopic measurements for the plant cell, *Amoeba proteus*, *Spirogyra, Euglena* and three types of bacteria. A set of questionnaires and exercises to assess student learning on hands-on microscopy were developed as well. The products of this project will be used by pre-service teachers in their science classrooms to attract students to the world of microscopy.

ARCHEOLOGY
SPRING 2014

DETECTING IRON-BASED PIGMENTS ON RUTHENIUM-COATED ARCHAEOLOGICAL POTTERY BY SEM-EDS AND BY MICRO-XRF-SEM. MICHAEL PENDLETON*[1], DOROTHY WASHBURN[2], E. ANN ELLIS[3] and BONNIE PENDLETON[4], [1]Microscopy and Imaging Center, Texas A&M University, College Station, TX, [2]University Museum, University of Pennsylvania, Philadelphia, PA, [3]Microscopy Consulting Technologist, P.O. Box 6124, Thomasville, GA, [4]Department of Agricultural Sciences, Canyon, TX.

A JEOL JSM-6400 scanning electron microscope (SEM) was used to produce secondary and backscatter images along with an energy dispersive spectroscopy (SEM-EDS) elemental map of a ruthenium-coated archeological pottery sherd. These secondary and backscatter images demonstrated the modulated charging effect produced by the ruthenium coating. This same sherd was used to produce a Micro-XRF-SEM elemental map using an X-ray source (IXRF Systems 10 micron X-beam Micro-XRF) along with a SEM (Hitachi S-3400N) with an IXRF Systems (30 mm) EDS detector. While the SEM-EDS system could only produce an elemental map of iron on the pigmented area of the sherd, the IXRF Systems EDS detector was able to produce elemental maps not only of iron in the pigment but of the elements present in the body of the sherd such as aluminum, potassium, calcium, sulfur, and silicon. The greater number of elements detected by Micro-XRF-SEM is due to the lower background of XRF compared to the background signals generated by the SEM beam in SEM-EDS. A charging effect is not apparent with Micro-XRF-SEM mapping so coating is not required for this method. Micro-XRF-SEM is more effective than SEM-EDS in identifying and locating trace elements in the pottery matrix of ancestral Pueblo pottery. Acknowledgments: The authors thank Kenny Witherspoon and Mandi Hellested of IXRF Systems for the Micro-XRF-SEM analysis of the sherd and for sharing their scientific expertise.

CORPORATE MEMBERS

Advanced Microscopy Group
Mark Rand
18421 Bothell-Everett Hwy #150
Mill Creek, WA 98021
mark.rand@amgmicro.com

AMETEK (EDAX), Inc.
Tina Wolodkowicz
392 East 12300 South, Suite H
Draper, UT 84020
(801) 495-2872
www.ametek.com

Boeckeler Instruments / RMC Products
Dave Roberts
4650 S. Butterfield Dr.
Tucson AZ 85714
(520) 745-0001
dave@boeckeler.com

Bruker AXS, Inc.
Andrew Robertson
8409 Sabrina Cove
Austin, TX 78747
(209) 603-6874
Cell (608) 346-1712
FAX (609) 771-4411
Andrew.Robertson@bruker-axs.com
www.bruker.com

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One Corporation Way
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Electron Microscopy Sciences/ DiATOME
Rob Armstrong
P.O. Box 550
1560 Industry Rd.
Hatfield, PA 19440
(800) 523-5874
FAX (215) 412-8450
sgkcck@aol.com
www.emsdiatome.com

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5350 NE Dawson Creek Drive
Hillsboro, OR 97124
(512) 417-8990
www.fei.com

Gatan, Inc.
Stephen Mick
5794 W. Las Positas Blvd.
Pleasanton, CA 94588
(925) 463-0200
FAX (925) 463-0204
info@gatan.com
www.gatan.com/

Hitachi High Technologies America
1375 N 28th Ave, P.O. Box 612208
Irving, TX 75261
(972) 615-9086
FAX (972) 615-9300
www.hitachi-hta.com

IXRF Systems
James Long
3019 Alvin DeVane Blvd, Suite 130
Austin, TX 78741
(512) 386-6100
FAX (512) 386-6105
jamesl@ixrfsystems.com
www.ixrfsystems.com

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sales@tedpella.com
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Tescan USA, Inc.
Mike Craig
508 Thompson Park Drive
Cranberry Township, PA 16066-6425
(724) 772-7433
mike.craig@tescan-usa.com
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Hyun Park
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