Northern California Chapter AVS 2016

Joint Users Group Technical Symposium

In conjunction with the Annual Equipment Exhibition

Materials, Devices, and Systems for Intelligent Engineering Solutions

Holiday Inn San Jose – Silicon Valley
1350 N. First Street, San Jose, California 95112
24 February 2016

Sponsored by

Agilent Technologies

UC COMPONENTS

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About AVS

History

On June 18, 1953, fifty-six people from diverse technical backgrounds, gathered in New York City to consider the need for a forum to discuss problems and applications of high vacuum technology. Six days later, the Committee on Vacuum Techniques was formally organized with the mandate to initiate a symposium and develop programs for education and for standards. The first symposium was held June 16-18, 1954 and attracted 295 registrants from several countries.

Until 1961, the Society was essentially comprised of the people attending the annual symposium, whose votes elected the officers and committee chairs for the succeeding year. At the 1957 Symposium, the membership changed the name of the group to the American Vacuum Society, Inc. A revised Constitution and By-Laws was adopted in 1961, establishing the current procedure of a mail ballot for the election of officers and directors.

AVS Today

As an interdisciplinary, professional Society, AVS supports networking among academic, industrial, government, and consulting professionals involved in a variety of disciplines - chemistry, physics, biology, mathematics, all engineering disciplines, business, sales, etc. through common interests related to the basic science, technology development, and commercialization of materials, interfaces, and processing area.

Each year, AVS hosts local and international meetings, publishes four journals, honors member through its awards and recognition program, provides training, and offers career services.

AVS is organized into technical divisions and technical groups that encompass a range of established as well as emerging science and technology areas. There are also regional chapters, international chapters and affiliates, and student chapters that promote communication and networking for professionals and students within a geographical region. AVS is comprised of approximately 4,500 members worldwide.

AVS is a member society of the American Institute of Physics with additional benefits for our members.

Northern California Chapter AVS

Overview

As a member-driven, interdisciplinary organization, AVS supports networking among academic, industrial, government, and consulting professionals involved in a variety of disciplines—chemistry, physics, materials science, engineering biology, mathematics, business, sales, etc. through common interests related to the basic science, technology development, and commercialization of materials, interfaces, and processing.

Founded in 1953, AVS is organized into technical divisions and groups that encompass a range of established as well as emerging science and technology areas. There are also regional chapters, international chapters and affiliates, and student chapters that promote communication and networking for professionals and students within a geographical region. AVS is comprised of approximately 4,500 members worldwide and welcomes all member and non-member scientists, technologists, students, and educators to participate in its national and regional events. Drawing members from materials science and vacuum-related industries, equipment suppliers, universities, and national labs, the Northern California Chapter of AVS (NCCAVS) is the Society's largest--supporting all of Northern California and Nevada with activities centered in the heart of Silicon Valley.

The concentration of semiconductor and magnetics- related industry in Northern California enables the Chapter to aim programs based on its traditional strength in vacuum technology toward exploring processes used in these rapidly growing industries. Through technical symposia and exhibitions, users group meetings, short courses and workshops, and other educational activities, the NCCAVS provides opportunities for scientists and technologists from the diverse fields that depend on controlled environments to interact and exchange ideas.

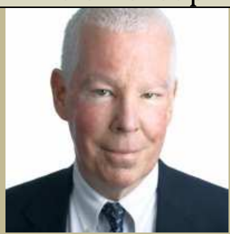
User Groups

User Groups provide a FREE forum for sharing technical knowledge and leading research, the NCCAVS is affiliated with and assists four technical users groups—Chemical Mechanical Polishing, Junction Technology Group, Plasma Applications, and Thin Films. These groups hold regular meetings during which members give technical talks on current developments in the field followed by a group discussion. Membership in each group is FREE and is not limited to AVS members.

Planning Committee

 **Mike Oye** moye@ucsc.edu NCCAVS Technical Symposium Chair University of California Santa Cruz	 **Chris Malocsay** chris_malocsay@avs.org NCCAVS Exhibit Chair Livermore Sales
 **Cesar Clavero** Cesar.Clavero@intermolecular.com NCCAVS Past Chair Intermolecular	 **Rachel Major** Rachel.major@nuleaftech.com NCCAVS Student Sessions Chair Drexel University/Foothill College
 **Gene Davis** g-davis2@ti.com NCCAVS CMPUG Texas Instruments	 **Susan Felch** sfelch@sbcglobal.net NCCAVS Program Chair Susan Felch Consulting

Planning Committee

 **Lucia Feng** lmfeng@earthlink.net NCCAVS PAG The OF Group	 **Zoran Misetic** zoranm@lesker.com NCCAVS TFUG Kurt J. Lesker Company
 **Paul Werbaneth** pfwerbaneth@gmail.com NCCAVS TFUG Intevac	 **Kamatchi Subramanian** pksubramanian12@yahoo.com PAG Chair 2015 PDF Solutions, Inc.
 **Michael Current** currentsci@aol.com NCCAVS Executive Committee Current Scientific	

Sing-Pin Tay singpin.tay@ieee.org NCCAVS TFUG	**David Webb** Vacuatech@juno.com NCCAVS Education Committee

Agenda

Time	Presentation
10:00-10:05am	Introduction and Welcome
10:05-10:55am	**Ray Zinn (Keynote)** "Lessons Learned After 52 Years in the Semiconductor Industry" ***Tough Things First*** *and Micrel Corp.*
10:55-11:30am	**Duane Bingaman** "Advances in Thin Film Technology: Low Pressure Sputter Source Deposition Using Precision Shadow Mask and Novel Sputter System Design for Precision Optics" *Kurt J. Lesker Company*
11:30am-12:05pm	**Markus Arendt** "Use of Excimer Laser Ablation for Patterning and Structuring" *Suss Microtec*
12:05-1:30pm	**Lunch**
1:30-2:05pm	**André Anders** "Non-Evaporative Getters (NEG) Coatings for Ultrahigh Vacuum Applications" *Lawrence Berkeley National Laboratory*
2:05-2:40pm	**Donald McClure** "Growth of Oxide Layers on Vacuum Deposited Metal Thin Films" *Acuity Consulting and Training*
2:40-3:15pm	**Min Hwan Lee** "Atomic Layer Deposition for Solid Oxide Fuel Cells" *University of California Merced*
3:15-3:30pm	**Coffee Break**
3:30-4:05pm	**Sang Lee** "Finding Customized Materials for New Device Needs" *Intermolecular*

Agenda

Time	Presentation
3:30-4:05pm	**Ernest Demaray and Adam Lambert** "Nearly Perfect Coupling of light to a Waveguide for Transmission, Conversion or Storage; 3D Nanometer scale, Finite Difference, Finite Time Thin Film Results" *Antropy Tech Inc.*
4:40-5:30pm	**Student Oral Presentations**
4:40-4:50	**Alan Feng** "Swarm Intelligence for Chemical Remote Sensing Applications" *Santa Clara University and De Anza/Foothill College*
4:50-5:00pm	**Erica Fagnan** "Graph-Theoretic Analysis of Nanocarbon Structures" *University of California Berkeley*
5:00-5:10pm	**Olga Kritova** "Design and Development of Micro- and Hypergravity Simulation Demo Systems for Plants in Space" *De Anza/Foothill College*
5:10-5:20pm	**Zeal Panchal and Rebecca Eliscu** "Analysis of *Vespa orientalis* Pigment and Silk for a Bio-inspired Material with Electrical Properties" *Sardar Patel University and Foothill College*

Agenda

Time	Presentation
5:30-7:00pm	**Student Poster Session**
	Dong Il Moon "Fabrication of a Silicon Nanowire on a Bulk Substrate by Use of a Plasma Etching and Total Ionizing Dose Effects on a Gate-All-Around Field-Effect Transistor" *NASA Ames Research Center*
	David Fryauf "Modeling the Growth of Ultrasmooth Silver Thin Films Deposited with a Germanium Nucleation Layer" *University of California Santa Cruz*
	Eric Singh "Plasma Jet Printing on Nanostructured Materials" *William S. Hart High School*
	Navathej Gobi and Darshan Vijayakumar "Study of Electrical and Mechanical Properties of Graphene Quantum Dots and Their Significance to Biomedical Engineering" *San Jose State University*
	Sowbaranigha Chinnusamy and Ravneet Kaur "Graphene Quantum Dot-Titania Nano Particle Composite Materials for Catalytic Water Splitting and Photovoltaic Applications" *San Jose State University*
	Juan José Díaz León "Hierarchical Moth-Eye Antireflection Coatings" *University of California Santa Cruz*
	Andres Arreola *San Jose State University*
7:00pm	**Conclusion and Prize Presentation**

Technical Speakers

Lessons Learned After 52 Years in the Semiconductor Industry

Ray Zinn

Author of **Tough Things First** and Founder and Former CEO of Micrel Corporation

Abstract

The future of sensors and the Internet of Things (IoT) can be read in the history of Silicon Valley and the semiconductor industry. With over 50 years in the business, and as the 37 year long CEO of Micrel, Ray Zinn personally created much of Silicon Valley history and has clear insight into what comes next.

In his keynote, Zinn will discuss how doing the Tough Things First has driven him, his company and the spirit of innovation in Silicon Valley. He'll describe how the semiconductor business cycle – which swoons based on innovation, adoption, growth and consolidation – explains the industry's current consolidation frenzy, and how China's role plays into both the current situation and the future. Zinn ties this together to how the next business and customer adoption cycles will drive both sensor technology and the IoT.

Biography

Ray Zinn is the author of the acclaimed book entitled ***Tough Things First***, the founder, and for 37 years, was the CEO of Micrel Corporation, a Silicon Valley microchip design and manufacturing company with international operations. Ray is credited with conceptualizing the wafer stepper, which was forward-looking at its time but is now a standard and critical equipment in every chip manufacturing facility worldwide. After exiting Micrel in 2015, Ray founded an entrepreneur accelerator named Mentor Capital to provide hands-on mentoring as well as funding to help business visionaries build profitable and enduring companies as well as to change the leadership foundations of Silicon Valley and technology hubs around the globe.

toughthingsfirst.com
rayd.zinn@gmail.com

Technical Speakers

Use of Excimer Laser Ablation for Patterning and Structuring

Markus Arendt

President of Suss Microtec Photonic Systems

Abstract

Excimer laser ablation is a direct etching process that uses the advantage of the Excimer laser source to emit high energy pulses at short wavelengths. The combination of the Excimer laser source and dedicated projection optics ensures the capability of high resolution imaging to pattern structures like RDL and vias for Advanced Chip Packaging. This complementary technology offers the promise of further reductions in manufacturing costs as well as enhancements in chip or package performance. In detail, a novel process using Excimer laser ablation as the critical method to integrate via and RDL traces in one patterning process step is proposed, based on the front end of line dual damascene integration flow for building multilayer stacks. Its technical robustness for the chip interconnect combined with its commercial benefits to users is demonstrated, and the capability of this Excimer laser process to extend the material selection to non-photo materials is covered.

Biography

Dr. Markus Arendt is President of SUSS MicroTec Photonic Systems, an equipment supplier for lithography solutions for Advanced Packaging, 3D Integration, and MEMS industries. Throughout his 10 years with SUSS MicroTec, he has held a range of senior-level positions, from Division Head for the Photomask Equipment Division to VP of Operations. Previously, he was General Manager of ANKA Synchrotron Radiation Source, and responsible for the commercialization of products and services with Synchrotron Radiation. Markus holds a Diploma in Engineering from the University of Karlsruhe/Germany, and a Ph.D. in Economics from the University of Heidelberg/Germany.

markus.arendt@suss.com

Technical Speakers

Non-evaporative Getters (NEG) Coatings for Ultrahigh Vacuum Applications

André Anders

Senior Scientist at Lawrence Berkeley National Laboratory

Abstract

When the pumping speed is greatly reduced by geometry constraints of the vacuum chamber, even the best pumps cannot ensure that ultrahigh vacuum (~ 10^{-10} Torr, ~ 10^{-8} Pa) can be reached. Some accelerator applications, for example, require very narrow beam pipes (pipe inner diameter 10 mm or even less) to obtain the desired control of beam position, shape, and intensity. The solution to this problem seems clear: the beam pipes and other narrow vacuum components need to BE THE PUMP. This has been pioneered at CERN by adding so-called non-evaporative getters (NEG) coatings, transition metal alloys such as Ti-Zr-V, to narrow chambers. They are "activated" by heating to about 200°C to let surface contaminations diffuse into the bulk of the coating, thereby enabling the absorption feature of the coating. We report on progress to coat very narrow vacuum chambers with NEG coatings using pulsed sputtering techniques at relatively high process gas pressures.

Biography

Dr. André Anders is a Senior Scientist and Leader of the Plasma Applications Group at Lawrence Berkeley National Laboratory, and the Editor-in-Chief of *Journal of Applied Physics*. He grew up in Germany and studied physics in Wrocław, Moscow, and Berlin, to obtain his PhD in physics from Humboldt University, Berlin, in 1987. Since 1992, he has worked at Berkeley on plasma technologies for materials, particularly thin film deposition. His publications are cited more than 11,000 times. He was the 2015 Chair of AVS' Advanced Surface Engineering Division.

andre.anders@gmail.com

Technical Speakers

Growth of Oxide Layers on Vacuum Deposited Metal Thin Films

Donald McClure

President of Acuity Consulting and Training

Abstract

The oxide layers on well-aged aluminum films were quantified using cross-sectional transmission electron microscopy. The aluminum films were evaporated onto polyester films using an industrial roll-to-roll metallizer at thicknesses from 6 to 40 nm. The aluminum films developed oxide layers at both the aluminum-air interface and the aluminum-polymer substrate interface. Both oxide layers for all aluminum thicknesses were consistently ≈3 nm thick. It was shown that the optical properties of the films as a function of aluminum thickness were well represented by traditional optical models. The measured electrical conductivity was higher than that of bulk aluminum, with the difference becoming greater for thinner films. Oxide layers on aluminum deposited onto polypropylene were found to be independent of the level of oxygen plasma treatment given to the substrate. This result was contrary to many expectations. The rates of growth of oxide layers on a variety of metal films were then analyzed by monitoring the optical transmission of metallized films as a function of time after deposition. We combine the results of these efforts to explain a number of interesting but, for the most part, unexplained phenomena related to metal deposition onto polymer films.

Biography

Dr. Donald McClure developed his skills as a vacuum roll-to-roll coating specialist during a 25 year career at 3M. Following his retirement in 2007, he formed Acuity Consulting and Training. He has worked on an extraordinarily broad range of programs including coating process development, product development and launch, coating out-sourcing, new machine design and specification, coater modification, project management, cost modeling, patent strategy development, and acquisitions. He has taught a variety of courses on vacuum web coating and sputtering across the US and in Europe and China. His classes have been reviewed as highly accessible and immediately useful. Don holds 24 US patents.

AcuityCT@hotmail.com

Technical Speakers

Atomic Layer Deposition for Solid Oxide Fuel Cells

Min Hwan Lee

Assistant Professor at University of California Merced

Abstract

Crucial processes in solid oxide fuel cell such as ionic transport and electrode reactions are thermally-activated processes and their kinetics are strongly dependent on the temperature. Despite intense recent efforts to reduce its operating temperature to address durability, cost and applicability issues, it is still an ongoing challenge to deal with the resulting sluggish kinetics and power losses at lower temperatures. In this talk, I will present an overview of how these issues have been successfully addressed by the use of atomic layer deposition (ALD). ALD has emerged as an important deposition technique for various applications due to its unique atomic-scale deposition capability in a highly controllable fashion at a temperature significantly lower than conventional chemical vapor deposition techniques.

Biography

Dr. Min Hwan Lee is currently an Assistant Professor of Mechanical Engineering at the University of California, Merced. Before joining UC Merced early 2012, he earned his master and doctoral degree in mechanical engineering from Stanford University, and his bachelor's degree from Seoul National University in Korea. His research centers on small-scale charge transport and electrochemical reactions within and at the interfaces of nanostructured oxides and carbons that form the basis of applications such as fuel cells, electrochemical energy storage and next generation data storage devices. He is an affiliate faculty of Biological Engineering and Small-scale Technologies (BEST) at UC Merced, and the Center for Information Technology Research in the Interest of Society (CITRIS).

mlee49@ucmerced.edu

Technical Speakers

Advances in Thin Film Technologies: “Low Pressure Sputter Source Deposition Using Precision Shadow Mask” and “Novel Sputter System Design for Precision Optics”

Duane Bingaman

Vice President of Kurt J. Lesker Company

Abstract

Precision shadow mask technology used together with low pressure sputtering enables the creation of sharp, well-defined features, with a feature shape consistent with those produced using evaporation. Masks can produce aperture sizes of 5 -1000 microns that can be aligned with a repeatability of 1 micron. This combination of mask and sputter source technology has been scaled to a 32” cathode size using a 24” mask and provides the possibility to remove expensive photolithography in certain process applications such as thin film battery, AMOLED, RFID.

The theme of precision is continued by presenting the design and capabilities of an innovative method of sputtering for the creation of precision optics. Using patented Isoflux inverted cylindrical sputter sources in a production capable tool we have demonstrated the ability to create films that have the quality of ion enhanced films, and require no masking to create uniform films on both flat and curved substrates. Unbalanced magnetron sputtering using mid frequency AC power is incorporated into the VIPER optical coating plant.

Biography

VP Kurt J Lesker Company—Process Equipment Division

BS Metallurgy Penn State University
5 years as Process Engineer in Semiconductor Industry
30 years with Kurt J Lesker Company in Sales and Marketing focused in the field of sputtering and thin film deposition

duaneb@lesker.com

Technical Speakers

Nearly Perfect Coupling of light to a Waveguide for Transmission, Conversion or Storage; 3D Nanometer scale, Finite Difference, Finite Time Thin Film Results

Ernest Demarary and Adam Lambert

Antropy Tech Inc. and Demarary LLC

Abstract

Previous FDFT models demonstrated AM 1.5 solar light could be coupled and concentrated into modes of a lateral lens duct with ~ 91% efficiency utilizing a high index tapered waveguide concentrator. In this talk we will present single wavelength results for efficient coupling and mode compression into high index waveguides with and without continuously graded index films on the order of 150-200nm with nonlinear profiles have been shown to be near ideal anti-reflective coatings. Such devices could be revolutionary not only in the field of photonics, but could also open the path for a wide variety of green energy and advanced lighting applications. The FDTD problem-solving framework provides the fully resolved time dependent propagation of the electromagnetic field, accounting for the nonlinear influence of subwavelength structures and allowing for detailed design of the thin film product. We are reporting 2D and 3D resolution in the 1-5nm range depending on the relevant length scales for the process. Quantification of power, absorption/heat, and other variables relevant to R&D can easily be extracted during post processing with YouTube video illustration of the dynamic transport of the light, including evanescent effects not available with ray vector or classical analytical methods.

Biography

Dr. Adam Lambert
Engineering Scientsist
Demaray LLC
lamberta@onid.oregonstate.edu

Dr. Ernest Demaray
Founder and President
Demaray LLC
ed@edemaray.com

Technical Speakers

Not Pictured

Finding Customized Materials for New Device Needs

Sang Lee

Intermolecular

Student Presenters

Fabrication of a Silicon Nanowire on a Bulk Substrate by Use of a Plasma Etching and Total Ionizing Dose Effects on a Gate-All-Around Field-Effect Transistor

Dong-II Moon[1], Jin-Woo Han[1], and Meyya Meyyappan[1],

1. NASA Ames Research Center

Abstract

The influence of the total ionizing dose (TID) on a gate-all-around (GAA) field-effect transistor (FET) is investigated. A suspended silicon nanowire (SiNW), which is an essential element for the fabrication of the next generation GAA FET, is fabricated on a bulk substrate by a plasma etching. The scallop pattern, generated during the Bosch process, is utilized. From the suspended SiNW, a GAA FET has been demonstrated on a bulk substrate. As the SiNW is fully surrounded by the gate, the fabricated device shows excellent electrostatic properties including short-channel immunity and radiation tolerance. The radiation-induced charges and traps in the gate spacers are found dominantly to govern the TID effect on GAA FETs. Moreover, the plasma etching route is further developed for vertically stacked SiNWs on the bulk substrate. The Bosch process is iteratively applied to make multiply stacked SiNWs, which can increase the on-state current. The proposed concept has advantages over other approaches in terms of low cost, CMOS compatibility, scalability, and radiation tolerance; this material can be thus considered as a promising structure for space applications.

Biography

Dong-II Moon received the B.S. degree from Department of Electrical Engineering and Computer Science, Kyungpook National University, Daegu, Korean, in 2008 and M.S. and Ph.D. degree from Department of Electrical Engineering, KAIST, Daejeon, Korea, in 2010 and 2015, respectively. He is currently a Post-Doctoral Researcher with Center for Nanotechnology, NASA Ames Research Center, Moffett Field, CA, USA.

dong-il.moon@nasa.gov

Student Presenters

Swarm Intelligence for Chemical Remote Sensing Applications

Alan Tao Feng[1], Kristopher McBrian[2], Razma Mogharab[1], Carlos Rivera[1], Luis Acevado[2], Anna Chang[2], Gui Paludeti[3]

1. Santa Clara University 2. De Anza College 3. Foothill College

Oral Presenter: Alan Tao Feng

Abstract

Swarm intelligence is based on the idea that robots can work together to solve problems and complete tasks without human intervention. Some important applications involve chemical air sampling and monitoring in remote locations. The basic setup we are following is to have one queen rover and having a collection of worker UAVs and rovers. One major necessity of swarm intelligence is being able to track the movements of every worker individually. Outdoors it is easy to track with GPS, but indoors GPS does not work. The purpose of this project is to develop an omni-directional antenna to track the position of each worker, whether it may be a rover or UAV coupled with RFID(Radio Frequency Identification) technology. We are building an array of antennas in order to locate the Radio Frequency transmitter we have on a worker robot. Depending on the voltage drop measured across the antenna we will be able to determine the direction of the worker to the queen accurately either in two-dimensions or three-dimensions. To determine the distance we will use RSSI(Received Signal Strength Indicator) technology. The first step of our project is to build an antenna to determine direction to the worker in two dimensions. The development of this technology will allow more precise measurements of position within a swarm system, inside or outside.

Biography

Alan Tao Feng is currently a junior Electrical Engineering student at Santa Clara University. In 2014, he began his involvement with the ZrAl NanoFoil and Outer Space Greenhouse project at the UC Santa Cruz and NASA-ARC Advanced Studies Laboratory, NASA Ames Research Center. He is now leading the rover swarm research project.

alantaofengc@gmail.com

Student Presenters

Graphene Quantum Dot-Titania Nano Particle Composite Materials for Photo Catalytic Water Splitting and Photovoltaic Applications

Sowbaranigha Chinnusamy[1], Ravneet Kaur[1], and Dr. Folarin Erogbogbo[1]

1. San Jose State University

Abstract

Titania (TiO_2) is a wide band gap semiconductor that exhibits photocatalytic activity, high resistance to photocorrosion, and stability when exposed to light. TiO_2 as a photo anode material faces some significant challenges such as poor absorption of visible light, high carrier recombination, and limited charge-carrier transport. To overcome these limitations, we propose the synthesis of a composite material using carbon based graphene quantum dots (GQDs) and TiO_2 nano particles. The hybrid combination of the nano materials is expected to decrease the recombination of charge carriers, increase charge carrier mobility and aids to improve the overall photo-conversion efficiency. The synthesized composite is characterized using scanning electron microscope (SEM) image, atomic force microscope (AFM) and UV-visible transmission spectrum.

Biography

Sowbaranigha Chinnusamy is currently doing her masters in Materials engineering from San Jose State University. She obtained her bachelor's degree in electrical and electronics engineering from Anna University, India. sowbacj@gmail.com

Ravneet Kaur is currently doing her masters in Biomedical engineering from San Jose State University. She received her B.S. and M.S. in Biotechnology from India. She also worked as a Manufacturing technician at Life Technologies. ravneet.kaur@sjsu.edu

Student Presenters

Study of Electrical and Mechanical Properties of Graphene Quantum Dots and Their Significance to Biomedical Engineeering

Navathej Gobi[1], Darshan Vijayakumar[1], and Dr. Folarin Erogbogbo[1]

1. San Jose State University

Abstract

Carbon Nanotubes (CNTs) are widely used as implants and biosensors, primarily because of their ability to provide structural and electrical enhancement to polymers. However, studies suggest that CNTs have following limitations: higher aseptic loosening, biocompatibility issues, and shell life. In this work, we propose Graphene Quantum Dots (GQDs) based polymer system with better properties and outputs. GQDs are nanometer-sized fragments of graphene, which show good electrical and mechanical properties. These properties make GQD, a strong candidate in biomedical applications such as biomaterials and biosensors. GQDs were synthesized from bird charcoal through the top-down approach. Synthesized GQDs were characterized to quantify the quality of synthesis. GQDs were infused into epoxy at different loadings to study its change in electrical and mechanical properties. It was found that the properties of epoxy were improved through the addition of nanoparticle. These superior properties open up wide variety of biomedical applications.

Biography

Navathej Gobi holds a Bachelor's degree in Biomedical Engineering from Anna University, India and is currently pursuing a Master's in Biomedical Engineering at San Jose State University. He has published articles in International Journals on his research work on developing assistive devices for paralytic patients.

Darshan Vijayakumar is a Biomedical Engineering graduate student at San Jose State University. After his Bachelors in Biomedical Engineering at Anna University, India, he worked as an Application Specialist at ADInstruments focusing on the patient monitoring systems. He has also worked at Alliance Biomedical.

navathej1992@gmail.com

Student Presenters

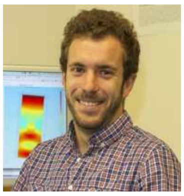
Hierarchal Moth-Eye Antireflection Coatings

Juan José Díaz León[1], Tiziana C. Bond[2], and Joshua D. Kuntz[2]

1. University of California Santa Cruz 2. Lawrence Livermore National Laboratory

Abstract

Undesired reflection from surfaces is a major challenge in optics. Antireflection coatings (ARCs) are intermediate structures designed to partially or totally eliminate reflection. We present the modeling of hierarchical structures as multi-band, wide angle antireflection coatings. The ability to decrease reflection for multiple frequency bands and angles would enhance the efficiency of optoelectronic conversion, laser beam shaping or light collection.



jdiazleo@ucsc.edu

Student Presenters

Modeling the Growth of Ultra Smooth Silver Thin Films Deposited with a Germanium Nucleation

David M. Fryauf[12], Junce Zhang[12], Matthew Garett[12], Logeeswaran VJ[3], Atsuhito Sawabe[4], M. Saif Islam[3], and Nobuhiko P. Kobayashi[12]

1. University of California Santa Cruz 2. NASA Advanced Studies Laboratories 3. University of California Davis 4. Aoyama Gakuin University

Abstract

The structural properties of optically thin (15nm) silver (Ag) films deposited on SiO_2/Si(100) substrates with a germanium (Ge) nucleation layer were studied. The morphological and crystallographical characteristics of Ag thin films with different Ge nucleation layer thicknesses were assessed by cross-sectional transmission electron microscopy (XTEM), reflection high energy electron diffraction (RHEED), X-ray diffractometry (XRD), grazing incidence X-ray diffractometry (GIXRD), X-ray reflection (XRR) and Fourier transform infrared spectroscopy (FTIR). The surface roughness of Ag thin films was found to decrease significantly by inserting a Ge nucleation layer with a thickness in the range of 1-2nm (i.e. smoothing-mode). However, as the Ge nucleation layer thickness increased beyond 2nm, the surface roughness increased concomitantly (i.e. roughing-mode). For the smoothing-mode, the role of the Ge nucleation layer in the Ag film deposition is discussed by invoking the surface energy of Ge, the bond dissociation energy of Ag-Ge, and the deposition mechanisms of Ag thin films on a given characteristic Ge nucleation layer. Additionally, Ge island formation, precipitation of Ge from Ag-Ge alloys and penetration of Ge into SiO_2 are suggested for the roughing-mode. This demonstration of ultrasmooth Ag thin films would offer an advantageous material platform with scalability for applications such as optics, plasmonics, and photonics.

bmb5220@gmail.com

Student Presenters

Plasma Jet Printing of Nanostructured Materials

Eric Singh[1], Ram P. Gandhiraman[2], Dennis Nordlund[3], Jessica E. Koehne[2], and M. Meyyappan[2]

1. William S. Hart High School 2. NASA Ames Research Center 3. SLAC National Accelerator Laboratory

Abstract

We have developed an aerosol-assisted atmospheric pressure plasma based deposition process for efficiently depositing functional materials. Nanostructured materials including silver nanowire (AgNW), carbon nanotubes (CNTs) and silicon dioxide dielectric coatings were deposited using atmospheric pressure plasma. In order to compare the plasma printed samples with non-plasma deposited samples, the control samples processed with no plasma were prepared with the same gas flow ratios and deposition time as the plasma coated samples. Helium was used as the primary gas source for igniting and sustaining the plasma. Preliminary experiments with argon yielded unstable plasma characterized by high current filaments with streamers. The role of plasma is observed to be activation of the material in the aerosol to coat the surface and accelerating the particles as the particles in the stream pick up additional momentum from the highly accelerated plasma gas. Local electronic structure and oxidation state of the plasma deposited materials were characterized using soft X-ray absorption spectroscopy (XAS). Fourier transform infrared spectroscopy (FTIR) was used to characterize the chemical structure of silicon dioxide dielectric coating. The morphology of the plasma deposited nanomaterials was characterized using scanning electron microscopy (SEM).

ericsingh555@yahoo.com

Student Presenters

Graph-Theoretic Analysis of Nanocarbon Structures

Erica Fagnan[1] and Robert Cormia[2 3]

1. University of California Berkeley 2. Foothill College 3. NASA Advanced Studies Laboratory

Oral Presenter: Erica Fagnan

Abstract

Nanostructures tend to comprise distinct and measurable forms, which can be referred to in this context as nanopatterns. Far from being random, these patterns reflect the order of well-understood laws of physics and chemistry. Under the aegis of physical and chemical laws, atoms and molecules coalesce and form discrete and measurable geometric forms ranging from repeating lattices to complicated polygons. Rules from several areas of pure mathematics such as graph theory can be used to analyze and predict properties from these well-defined structures. Nanocarbons have several distinct allotropes that build upon the basic honeycomb lattice of graphene. Because these allotropes have clear commonalities with respect to geometric properties, this paper reviews some approaches to the use of graph theory to enumerate structures and potential properties of nanocarbons. Graph theoretic treatment of the honeycomb lattice that forms the foundation of graphene is completed, and parameters for further analysis of this structure are analyzed. Analogues for modelling graphene and potentially other carbon allotropes are presented.

erfagnan@ocf.berkeley.edu

Student Presenters

Analysis of *Vespa orientalis* Pigment and Silk for a Bio-inspired Material with Electrical Properties

Zeal Panchel[12], Rebecca Eliscu[3], Kristy Nguyen[3], Rachel Major[34], Johan Saltin[3], Alessandro Rupp[3], and Robert Cormia[35]

1. De Anza College 2. Sardar Patel University 3. Foothill College 4. Drexel University 5. NASA Advanced Studies Laboratory

Oral Presenters: Zeal Panchal and Rebecca Eliscu

Abstract

A major application of bio-inspired design is using a combination of genetics and nanotechnology to tailor the function of biological substances. NuLEAF Tech seeks to use bio-inspired design to create electricity from plants by genetically engineering an electrical material. The focus of our research is on the silk and pigment of Vespa orientalis, which exhibit thermoelectric and photovoltaic properties, respectively. The silk begins as a proteinaceous mixture, that, upon exposure to air, polymerizes into a dual-layered fiber and becomes an organic semiconductor, exhibiting thermoelectric properties at biologically friendly temperatures. The four major proteins of the silk have been identified and sequenced, which creates an exciting ability to open the doors for genetic engineering of the material. In contrast, the hornet cuticle consists of a yellow and brown pigment. The yellow pigment is primarily responsible for the photoelectric property. This is likely possibly by photons creating an electric field that polarizes the proteins to form oppositely charged parallel plates and creating an electric capacitor.

rebeliscu@gmail.com
panchalzeel.35@gmail.com

Student Presenters

Design and Development of Micro- and Hypergravity Simulation Demo Systems for Plants in Space

Olga Kritova[1] and Kevin Glass[2]

1. Foothill College 2. De Anza College

Oral Presenter: Olga Kritova

Abstract

The current trend of emerging scientific technologies in space travel indicated a need for a long-term food source to be available to our astronauts. This closed loop system concept is not new, but the research on the effect of variable gravity (amongst other environmental factors) on plants is still ongoing. The purpose of this project is to design and develop systems on Earth to simulate different environmental conditions for plant growth off Earth. Our current tests include experimentation on *Brassica rapa* via a custom built centrifuge to control applied g-force, simulating macrogravity. The seed is grown in a variety of mediums and observed for time of germination, length and thickness of root and shoot, and orientation of the plant. This data serves to build understanding about the structure of plant growth and the variables that affect physical and chemical composition of the plant. Future study will include testing nutritional viability, effect of isolated light waves on plant, and attempts to create a system that simulates microgravity on Earth.

olga@kritov.com

Student Presenters

Andres Arreola[1]

1. San Jose State University

Presenter: Andreas Arreola

Abstract

Multimodal nanoprobes for oncology are an exciting regime in the life sciences. The research goals for Wolcott lab is to focus on the surface of nanodiamonds (NDs) that host the fluorescent nitrogen vacancy center (NVC). High-temperature high-pressure NDs are non-cytotoxic, fluorescently stable and the NVC can detect magnetic and electric fields via optical microscopy. We employ various surface motifs to enhance both the sensing capabilities and staining capabilities of the ND probes. There are many open questions concerning ND surface chemistry and the field is ripe for investigation. We utilize both solid-phase and colloidal chemistry routes to modify the ND surface and use a myriad of surface sensitive techniques to verify our findings. NDs will be engineered for the targeted labeling of pancreatic and ovarian cancer cell lines, making it possible to track activity for minutes to hours. We envision new paradigms of sensing emerging from our work using the NVC.

andres.arreola@sjsu.edu

Exhibitors

The technical symposium is in conjunction with Annual Equiptment Exhibit. List of exhibitors as of 19 February 2016.

AARD Technology	EP Laboratories
Advanced Energy	Evactron by XEI Scientific Inc.
Agilent	Fabyield Technologies
Alicat Scientific	FloDynamix LLC
Anderson Dahlen Vacuum / Applied Vacuum Technology	FMG
Atlas	Gamma Vacuum
Atlas Fibre	Gencoa
Avantes Inc	GNB Corporation
Balazs Nanoanalysis - Air Liquide	HeatWave Labs Inc.
Brooks	Hiden Analytical
Busch LLC	Huntington Mechanical Laboratories, Inc
Cacejen Vacuum	INFICON
Calweld Inc.	InstruTech
Clean Sciences Technology	Intellivation
Cosmotec	Kashiyama USA
Cryosciences	Kaufman & Robinson
CS Clean Systems	Key High Vacuum
Denton Vacuum	KLA-Tencor
Duniway Stockroom Corp	Kratos
EAG	KSM Vacuum Products
Ebara	Kurt J. Lesker Company
Edwards Vacuum	Labtec Sales, Inc
Electron Microscopy Sciences	Larson Glass

Exhibitors

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MDC Vacuum	Shimadzu
MeiVac Inc.	Sierra Applied Sciences, Inc.
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Milestone Technology	Sputtering Components Inc.
MPF Products, Inc.	SynsysCo
Nor-Cal Vacuum Products	Telemark
Novati Technologies Inc.	TGM Incorporated
NSI Nuance Systems	Thermionics Lab Inc.
Oerlikon Leybold Vacuum	Thermofisher Scientific
Osaka Vacuum	UC Components
Pentagon	UHV Transfer Systems Inc
Perkin Elmer	Vacuum Engineering and Materials
Pfeiffer Vacuum	Vacuum Instrument Corp./VIC Leak Detection
Physical Electronics	Vacuum Research Corp
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Precision Plus Vacuum Parts	Vivid Inc
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