PHYSICS AND MATHEMATICS PAPER ABSTRACTS

RECENT PROGRESS IN HOLOGRAPHIC IMAGING OF OPALS. *D. BRIAN THOMPSON*, UNIVERSITY OF NORTH ALABAMA.

A Denisyuk reflection hologram is created by placing a holographic plate in front of an object so that the object is illuminated through the plate by a diverging, monochromatic laser beam. In this setup, a holographic image of the object is created by light wave interference between the incident beam and laser light reflecting off the object. Then the monochromatic holographic image can be reconstructed by illuminating the reflection hologram with a white light source. We have begun using several different colors of incident laser beams to produce full-color reflection holograms. We select gem opals as the objects to be imaged. The flashes of color in gem opals result from light wave interference, and so full-color reflection holograms are especially suited to reproducing these flashes of color. Here I demonstrate progress we've made in producing these holograms and set future goals for this project.

IN SITU CURRENT-VOLTAGE CHARACTERISTICS OF CDZNTE IN EXTREME THERMAL ENVIRONMENTS. *TYLER RICHARDSON*, MATTHEW DOWDELL, ROBERT E. SMITH II, EMMANUEL JODA, OLASUNKANMI ROWLAND, JONATHAN S. LASSITER AND STEPHEN O. BABALOLA, ALABAMA A&M UNIVERSITY.

There is a need for robust detection systems capable of operating in extreme thermal conditions, and Cadmium Zinc Telluride (CZT) shows promise for detection in extreme environments. CZT has been proven to be an effective room temperature radiation detection material with applications in medical imaging, nuclear non-proliferation, reactor monitoring, as well as gamma- and X-ray astronomy. This work was guided by research characterizing the electrical properties of CZT crystals following thermal treatments, however, in situ electrical properties characterization is needed to mimic real-life applications during exposure to environments with elevated temperatures. These experiments served to evaluate the electrical properties of CZT detectors during operation at elevated temperatures. I-V measurements were obtained while the detector, placed inside of a furnace, in the range of 20oC – 400oC. The results of this series of experiments is important in the application of radiation detection in extreme temperature environments, and the design of robust detection systems capable of effective operation during exposure to extreme conditions. In this study the I-V profiles of nuclear radiation detectors fabricated based on Cadmium Zinc Telluride (CdZnTe or CZT) semiconductor crystals are obtained and analyzed. The I-V notes a logarithmic decrease in resistivity to 200oC, and the deterioration of electrical properties is less drastic beginning with measurements at and following 250oC. The results of this study indicate that a CZT detector system can operate up to 100oC with minimal modifications to a detector configuration, beyond that point, further modifications will likely be required.

PHYSICS AND MATHEMATICS POSTER ABSTRACTS

THE FABRICATION OF ZINC OXIDE FILMS FOR SENSOR APPLICATIONS. *JEMILIA POLIUS* AND DR. MOHAN AGGARWAL, ALABAMA A&M UNIVERSITY.

In this work, the sol-gel and dip coating methods were used to fabricate zinc oxide (ZnO) films on quartz (SiO2) substrates under normal laboratory conditions. The thin films were synthesized via the sol-gel method by the hydrolysis of zinc acetate as the zinc precursor, isopropanol as the solvent medium, and monethanolamine as the stabilizing agent. The substrates were cleaned and coated using the dip coating apparatus to prepare thin films that consisted of 2 layers. Two cast films were prepared: one unannealed and the other annealed at 500°C by direct insertion in a furnace operated under atmospheric conditions. FTIR and Raman analysis of the resulting films were made to monitor the decomposition and oxidation reactions that occur during the fabrication process as well as process stability. The results of this study revealed that we successfully fabricated ZnO films in a simple and low cost method that could produce an n-type material for use in energy harvesting or other sensor applications.

We greatly acknowledge the support of Alabama Space Grant Consortium funding for supporting this research.

FACTORS AFFECTING RESISTIVITY OF CDZNTE CRYSTALS AT ELEVATED TEMPERATURES. *MATTHEW DOWDELL,* MATTHEW DOWDELL, OMOLOLA OJEWOLE, TYLER RICHARDSON, ROBERT SMITH II, JONATHAN LASSITER AND STEPHEN BABALOLA, ALABAMA A&M UNIVERSITY.

Cadmium Zinc Telluride (CdZnTe) crystals are of great interest due to the material's attractive properties and high stopping power for room-temperature X-rays and high energy gamma radiation detection applications such as in medical, industrial and astrophysical fields. Its ruggedness and ability to shape into small sizes further expands its scope of potential uses. To extend the use of devices based on CdZnTe crystals, the performance of the material at elevated temperatures should be studied, and is the focus of our parallel study. The aim of this work is to understand the observed changes in material properties of CdZnTe crystals at elevated temperatures. This work explores two factors, namely, surface and bulk impurities, as contributing factors to the observed changes. The embedded defects within the material, mainly inclusions, and surface morphology are studied at high temperatures and are presented in this work. The observed changes in morphology of the inclusions within the bulk of the materials at 400oC and other temperatures are shown.

MEASUREMENT OF IMPEDANCE OF LITHIUM ION BATTERY USING ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY. *SALAH ELAFANDI,* AKSHAYA KUMAR AND PRAKASH SHARMA, TUSKEGEE UNIVERSITY.

Lithium-ion batteries have gained tremendous interest in the recent years because of their rechargeable property, low self-discharge and high energy density storage. Now days, they are widely used in portable electronics, military devices, electric vehicles and many aerospace applications.

In our research, we are using electrochemical impedance spectroscopy (EIS) to observe internal impedance changes under different state of charge conditions of lithium ion battery. EIS is a very powerful tool to gain insight into the structure and internal behavior of low impedance electronic storage devices such as batteries and super-capacitors. Our goal is to explore the internal structural changes in the battery at different state of charge conditions.

EIS is executed by applying a small sinusoidal potential (or current) to the battery for a wide range of frequencies. Then, we measure the response in terms of Impedance magnitude (Z), and a phase shift (Φ). The data observed is plotted in two ways known as Bode Plot and Nyquist plot to analyze the response of the battery.

Our research could lead to better understanding of performance of li-ion batteries and their internal structural behavior in different state of the charge conditions.

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UTILIZATION OF UV-V'S PHOTO- REDUCTION PROCESSES. *PRAKASH SHARMA*, AKSHAYA KUMAR AND SALAH ELAFANDI, TUSKEGEE UNIVERSITY.

Utilization of solar energy (UV-V's) and a coupling of novel semiconductor oxide nano-particles have been recently demonstrated with enhancement in oxidation and/or photo-reduction processes for the water/air detoxification and sustainable liquid fuel production respectively. For the successful physical adsorption of hydrogen molecule, we have developed novel polyaniline nanostructures via chemical templating and electrospinning Chemical or complex hydrides involving nano-MgH2 and transition metal nano-catalysts have been synthesized to tailor both the thermodynamics and kinetics of hydrogen (chemi) sorption respectively.

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PRODUCTION OF HYDROGEN FROM SOLAR ENERGY. *PRAKASH SHARMA*, SALAH ELAFANDI AND AKSHAYA KUMAR, TUSKEGEE UNIVERSITY.

The hydrogen is produced from the clean sources such as solar energy and water, it has to be stored by physiorption or chemisorption processes on to the solid state systems. We have developed nanofibers, nanotubes, and nanoparticles for clean energy. Based on the principle that the energy can be converted from one form to another, the chemical energy such as hydrogen is produced from the electrolysis of the water at a much lower voltage using RuO2

nanoparticles on the Si wafer substrate. Acknowledgements: The authors will like to acknowledge NSF for providing funding to support the work.

MODEL FOR PHOTOCATALYTIC AIR DISINFECTION. *SALAH ELAFANDI,* AKSHAYA KUMAR AND PRAKASH SHARMA, TUSKEGEE UNIVERSITY.

Various parameters such as light irradiation, photocatalytic air filter location, gas purging and sampling etc. were optimized via experimental models and develop a model for inactivation of microbes in a filter fiber media using mathematical and experimental data. Photocatalytic air disinfection (PAD) systems are used. The goal is to ensure that the proposed models are true representations of photocatalytic air disinfection. The models developed would be tested against experimental results. Acknowledgements: The authors will like to acknowledge NSF for providing funding to support the work.

PROBABILITY AND STATISTICS OF THE RAREST PHENOMENON IN CRICKET. *ARJUN TAN,* ARJUN TAN AND ALMUATASIM ALOMARI, ALABAMA A&M UNIVERSITY. MARIUS SCHAMSCHULA, ALABAMA A&M UNIVERISYT.

The Three Ws of West Indian cricket of Worrell, Weekes and Walcott have been labelled as the rarest phenomenon in cricket history. The batting careers of the Three Ws were nearly identical and their batting statistics were unusually similar. The resemblance coefficients for qualitative attributes between the Three Ws were 93.33% and above. The resemblance coefficients for quantitative attributes between the Three Ws ranged from 87.55% to 91.69%. The area within which the Three Ws were born is calculated to be merely 1.11 km2 using a Circle scheme, or 0.96 km2 using a Tri-focal Ellipse scheme. The magnitudes of the highest scores of the Three Ws were within 3% of one another; and they were all unbeaten, the probability of which is estimated at 3.7%. Finally, the probability that the Three Ws were all born in Barbados and had surnames beginning with W is estimated as 7.41 in a million!

OBTAINING EXACT VALUES OF SIN(Nπ/7). *ARJUN TAN,* ARJUN TAN, ALMUATASIM ALOMARI AND MARIUS SCHAMSCHULA, ALABAMA A&M UNIVERSITY.

Exact values of trigonometric functions are much sought after for their exactness and aesthetic appearance. These include trigonometric functions of sub-multiples of π. In this study, analytical expressions of sin(nπ/7), where n is a positive integer, are found by expanding the function as a polynomial, solving a cubic equation and extracting the square root of that equation. The solutions, even though not in the traditional form involving only integers and their roots, are nonetheless exact and complete. A geometrical representation and a geometrical construction provide great elegance and clarity to this method.