Raman spectra of the Interaction of Antifreeze Glycoprotein and Ice

Andrea M. Sease
Department of Physics
Fisk University
1000 17th Ave North
Nashville, TN 37208

Advisors:
Dr. Arnold Burger, Dr. Mingsheng Guo,
Dr. Yunlong Cui, Mr. Ratsgo Hawrami

Abstract

The interaction of antifreeze glycoprotein (AFGP) and ice were observed using He-Ne laser to excitation. The resulted Raman spectra were slightly different from previously obtained. New peaks found are thought to be caused by the interaction of the ice and the protein through a C-O bond.

The Basics of Mathematica

Buford Richardson, II
Department of Physics
Fisk University
1000 17th Avenue North
Nashville, TN 37208

Faculty Advisor:
Dr. W.E. Collins

Abstract

The purpose of my research was to learn how Mathematica works and completely become capable of using it in any kind of application that was given. This was done by continuously working on the Mathematica program; learning how to use different functions and graphs so that they can be used in future research plans. Currently, Mathematica is being applied in the field of Quantum Mechanics checking different functions and seeing if the functions satisfy the equation that was focused on. The results were varied, and more time is needed to get better results.

Keywords: Mathematica, derivatives, integration, plotting, Schrödinger equation

Fabrication and characterization of TiO_2 NanoRods

Dawit Jowhar and Akira Ueda and Richard Mu
Department of Physics
Fisk University
1000 17th Avenue North
Nashville, TN 37208, USA

Faculty Advisor:
Richard Mu

Abstract

The earth's natural resources have been depleting by rising energy needs. The sun has been proven to be an inexhaustible resource. If properly harnessed, it would more than satisfy the needs of humanity. Conventional solar cells that are being implemented currently have a theoretical efficiency of 40%. This efficiency can be increased by using nanocomposite solar cells. The predicted efficiency is going to be 66%. The use of quantum dots on the nanorods helps to collect broader wavelengths of photons, thereby enhancing the conversion efficiency of the solar cells. TiO_2 has been chosen as a suitable nanorod material in a photovoltaic cell. It is a wide band gap semiconductor, which facilitates the transport of electrons and is easily available. Several thicknesses of TiO_2 were deposited on silica using e-beam evaporation. Thermal treatments were applied at various temperatures and annealing time. UV-VIS and FTIR spectra were collected and some experimental analysis has been done. In my presentation, I will be sharing my experimental results followed by discussion.

Study of Mobility-Lifetime on a IMARAD $Cd_{1-x}Zn_xTe$ Radiation Detector

Eric Woodard
Department of Physics
Fisk University
1000 17th Avenue North
Nashville, TN 37208 USA

Faculty Advisor:
Mr. Groza, Dr. U. Roy, Dr. A. Burger, Mr. Babalola

Abstract

$Cd_{1-X}Zn_xTe$ (CZT) is an attractive semiconductor material for room temperature x-ray and gamma-ray detector applications [1]. An IMARAD 20x20x5 mm^3 CZT crystal was the sample utilized in this study. The detector was polished with .05 □ alumina particles, the crystal was etched in 1% Bromine in Methanol solution. We used room temperature photoluminescence mapping on both large (20x20 mm^2) faces to observe the zinc distribution at the surface of the crystal. The variations in the Zn index were relatively

large (~10%) throughout the crystal. Four different planar detectors have been fabricated on each of the four quadrants and the detectors were characterized. The characteristic of the crystal that was being focused on was the mobility-lifetime product. Mobility-Lifetime was measured for all four Cadmium Zinc Telluride (CZT) detectors using an alpha source of Americium 241. Mobility-Lifetime product is an important value because it informs us about the crystal performance and it was obtained when experimentally obtained values of channel number and voltage were plugged into Hecht's Equation [1].

Technique of Fabricating Well-Ordered Nanospheres

Francinia S. McCartney and Julie K. Rogers
Department of Physics
Fisk University
1000 Seventeenth Avenue North
Nashville, TN
37208-3051. USA
Faculty Advisor: Dr. Marvin H. Wu

Abstract

Molecular detection and identification is of great interest in various disciplines such as analytical chemistry, molecular biology, pharmacology, nanotechnology, and environmental science. In recent years, surface-enhanced Raman spectroscopy (SERS) has emerged as one of the most sensitive spectroscopic tools available for the detection of a wide range of adsorbate molecules [down to the single molecule detection limit.] SERS involves spectral measurement of the inelastically scattered light from an analyte material (e.g., molecules) adsorbed or surrounded by metal nanoparticles. These metal nanoparticles can be made via a method called nanosphere lithography. Nanosphere lithography is an inexpensive and reproducible way of uniformly depositing spheres on suitable substrates as a mask. Electron beam vaporization is then used to deposit a layer of gold through the mask. After sphere removal, the nanoparticles are left. This paper focuses on the production of these nanosphere masks that are used to make nano-particles used to enhance Raman scattering of light.

The fabrication and characterization of indium tin oxide and Photo-voltaic cells.

Adebiyi
Department of Physics
Fisk University
1000 17th Avenue North
Nashville, TN 37208 USA
Advisors: A. Ueda and R. Mu.

Abstract

This research concentrates on the construction of better solar panels for the upcoming future. I was assigned in a group for the production for nano-composite cells in a group of four people and two advisers.

I was assigned the role of studying the properties of Indium tin oxide whether it could be used as an electrode in thre nano-composite cell. With the help of machineries such as the UV-visible spectrum, FTIR spectrometer and the Van der pauw system, I am able to determine whether the Indium tin oxide on silica glass will serve as an excellent electrode in the nano-composite cell being produced.

Keywords: Indium tin oxide, nano-composite cell, UV-visible spectrum, FTIR spectrometer, Van der pauw system.

Raman Spectroscopy of Antifreeze Glycoprotein and its Interaction with Highly Oriented Pyrolytic Graphite Substrates

Issa E. Smith, Andrea Sease, and Vincent Alexander
Department of Physics
Fisk University
Nashville, TN 37208-3051. USA

Faculty Advisors:
Dr. Arnold Burger, Dr. Yunlong Cui,
Dr. Mingsheng Guo, Mr. Rastgo Hawrami

Abstract

Raman spectra were taken from two samples of antifreeze glycoprotein (AFGP) 0.2 mg/ml adsorbed onto highly oriented pyrolytic graphite's (HOPG) surface. The laser used in the Raman spectrometer device was He-Ne 632.8 nm. The AFGP on HOPG samples Raman spectra were observed from a 50 cm^{-1} to 4000 cm^{-1} range (Fig. 4) The AFGP 0.2 mg/ml on HOPG sample displayed new peak at 1002 cm^{-1} . The new peaks indicate that adsorption has taken place at the interface of AFGP on HOPG.

A Mathematical Model to Compute the Optimal Intensity of the HIV/AIDS Virus

Jonathan Lewis
Department of Physics
Fisk University
1000 17th Avenue North
Nashville, TN

Faculty Advisor:
S. Hota PhD, Department of Mathematics

Abstract

Differential equations are used in mathematical modeling to model or represent problems that are related to the spread of diseases in a biological population. In this paper the spread of a disease with a population is analyzed and developed into a differential equation which denotes the results of the experimental data. From this differential equation, the optimal intensity of the disease and amount of time needed can be obtained and evaluated until the complete population is infected.

Raman Spectroscopy and Nanosphere Lithography

Julie K. Rogers, Francinia McCartney
Department of Physics
Fisk University
Nashville, TN 37208. USA

Faculty Advisor:
Dr. Marvin Wu

Abstract

This experimentation used nanospheres to study biological sample. The samples were to be observed under the Atomic force microscopy (AFM) for a detailed surface analysis. The last and final step was to run the samples through the Raman spectroscopy to determine its chemical composition

Thermal and Optical Study of Yttrium Aluminum Borate Glasses and Glass-Ceramics

Marcia Hays
Department of Physics
Fisk University
1000 Seventeenth Ave. North
Nashville, TN 37208-3051. USA

Faculty Advisors:
Dr. Steve Morgan and Dr. Zhengda Pan

Abstract

Study of yttrium aluminum borate glass used differential scanning calorimetry (DSC), absorption and emission spectroscopy (photoluminescence). Rare earth ions, erbium and europium, were chosen as dopants. The key objectives were to achieve uniform bulk crystallization, durability, transparency, and luminescence. Several heat treatments were preformed in order to reach the goal of a transparent glass

ceramic. The glass transition temperature and the crystallization temperature were found by DSC. Absorption and emission spectra revealed optical transition properties of Er^{3+} in Y_2O_3-Al_2O_3-B_2O_3 system.

Thermal and Optical Analysis of Erbium doped Yttrium Aluminum Borate Glasses and Glass Ceramics

Nicole Hart
Department of Physics
Fisk University
1000 Seventeenth Ave. North
Nashville, TN 37208-3051. USA

Faculty Advisors:
Dr. Steven Morgan, Dr. Zhengda Pan

Abstract

The properties of transparent glass ceramics (TGCs) are discussed. A particular glass composition, $15Y_2O_3 \cdot 25Al_2O_3 \cdot 50B_2O_3 \cdot 10Na_2CO_3 \cdot H_2O$, is doped with one mol percent of Eu_2O_3 for one sample and Er_2O_3 for another with the intention of studying the glasses' optical properties. DSC graphs of the Erbium doped glass are analyzed to obtain effective heat-treatment temperatures. Luminescence graphs show the difference between the glass state and the glass ceramic state. Due to the particular glass matrix, heat treatments resulted in glass crystallization beginning on the glass's surface and continuing toward the center (also known as devitrification [2]), creating a glass ceramic exterior and a glassy interior within a single sample. This characteristic defies the previously discussed optimal crystallization behavior in TGCs, uniform bulk crystallization, and thus fails to produce a transparent glass ceramic. Future possibilities for alternate nucleating agent are discussed.

Fabrication and Characterization of ZnO for nanocomposite solar cells

Dionicia O'Berry
Department of physics
Fisk University
Nashville, TN 37208

Faculty Advisor
Dr.Akira Ueda, Dr.Richard Mu

Abstract

Nanotechnology offers promise for renewable energy technologies. On the one hand, the precise control of matter at atomic and molecular level is a requirement for renewables such as cost effective solar cells, which is much cheaper and more lightweight than bulk. Conventional solar cells have a theoretical photoelectrical efficiency of ~ 40%. Predicted efficiency for nanostructures can be up to 66%. This could significantly increase the amount of electricity converted from sunlight by using nanostructured active layers by more effective light absorption. Recently, the Nano-PV research team has proposed a new solar cell structure which is based on the photoelectrochemical cell structure by replacing two key components of the cell: 1) using semiconductor quantum dots to replace the conventional dye molecules and 2) employing 1-dimensional nanowires/nanorods to substitute the typical TiO2 nanocomposite electrode. With this structure, it is possible to improve solar cell performance drastically. As a part of team efforts, I have been focused on development of ZnO nanorods structure. In my presentation, I will be presenting some of my work obtained during the summer internship.

Keywords: Zinc Oxide; Nanorods; solar cells; Nanostructures

"Energy Upconversion studies of oxide glasses co-doped with Nd^{3+} and Ho^{3+}"

Marcus Odums
Department of Physics
Fisk University
1000 17th avenue North
Nashville, TN 37208. USA

Faculty Advisor:
Dr. S. Ray Bullock

Abstract

A multi-element oxide glass co-doped with Nd^{3+} and Ho^{3+} was prepared to investigate the energy upconversion phenomena. The glass composition was evaluated initially for temperature restraints as far as vaporization was concerned. Some of the chemicals reacted with porcelain hence we used an alumina crucible. The glass initially created much scattering due to the cooling process in the ambient atmosphere. The absorption spectrum of the sample displayed intense peaks at 802nm, 750nm, 648nm, 575nm, 545nm, and 450nm.

"Mobility - Lifetime of an IMARAD Cadmium Zinc Telluride (CZT) Crystal"

Omari Paul
Department of Physics
Fisk University
1000 17th Avenue North

Nashville, TN 37208 USA

Advisor: Mr. M Groza, Dr. U Roy, and Dr. A Burger

Abstract

Cadmium Zinc Telluride (CZT) crystals are semiconductors material used to detect different types of radiation. The fabrication process is first in the development of the detector. The crystal was sized at 20 x 20 x 5 mm^2. After which we polish the crystal with different size grit paper to eliminate surface defects. Etching the crystal with 1% Bromine in Methanol solution is the last step of fabrication. We then begin to characterize the crystal. Zinc distribution was observed on both 20 x 20 faces using room temperature photoluminescence mapping. On the 20 x 20 surface we placed four Au contacts on each quadrant of the surface (□.□ □̃ □.mm).

The Investigation of Carbon Nanotubes Grown at Different Annealing Temperatures and Pressures

Shona Paul
Department of Physics
Fisk University
1000 17th avenue North
Nashville, TN 37208 USA

Abstract

Carbon nanotubes (CNTs) are structures that are used in devices to enhance performances. Observations were made to find out which of the experimental procedures of CNT production were optimal. The variable of temperature plays an important role in how CNTs grow. Atomic force microscopy and Raman spectroscopy were used to analyze 6H-SiC wafers that were annealed at 1400 ^{0}C and 1600 ^{0}C for the production of CNTs for 30 min. The CNTs showed increased growth with respect to an increase of temperature. The Raman data indicated an increase in frequency of the D-band and G-band readings with respect to the diameters of the CNTs.

Key words: Carbon nanotubes, Silicon carbide, nanotubes, and annealed

Serotonin$_{2C}$ Receptors (5HT$_{2C}$) and Phenylketonuric Rats

Terry Leroy Robertson, Veronica Mackey
Department of Biology
Fisk University
1000 17th Ave. North
Nashville, TN

Faculty Advisors:
J. Ike PhD, Department of Biology

Abstract

Phenylketonuria is a relatively common cause of profound mental retardation. In this research, experimental received α-methlyphenylalanine and phenylalanine. Control rats are given saline solution alone. Alpha-methylphenylalanine decreases the body weight of experimental pups as compared to control (Huether and Neuhoff 1981). Furthermore, there was decrease in protein concentration in experimental membrane homogenate versu control. These results suggest that Phenylketonuria (PKU) was induced in the rats.

CZT Detector Fabrication and Characterization IMARAD Grown CZT:Detector Performance vs. Zinc Distribution

Stephanie Turner
NASA's Center for Photonic Materials and Devices
Fisk University
One Thousand Seventeenth Avenue North
Nashville, Tennessee 37208, USA

Faculty Advisors:
Michael Groza, Dr. Arnold Burger, Dr. Utpal Roy

Abstract

The Materials Science group of the Summer Research Program was assigned the task of fabricating and characterizing Cadmium Zinc Telluride detector crystals. The group received an IMARAD-grown CZT crystal to be characterized and to determine the efficiency of its detection properties. The dimensions of the detector were 20x20x5 mm^3. Several lab tests were performed on the crystal to help with the characterization process. However, before the characterization process began, the detector was polished and chemically etched using special lab procedure. The characterization measurements were taken after four gold circular contacts were deposited on the two faces of the crystal. After data was sufficiently collected, it was determined that the zinc distribution did have some impact on the detector performance of the crystal. It was also determined that the detector contained significant internal structural defects preventing conclusive data from being attained on the zinc distribution.

Raman Spectroscopy on Antifreeze Glycoproteins Interacted with Mica

Vincent P. Alexander
Department of Physics
Fisk University
1000 17th, Avenue
North Nashville, TN. 37208. USA

Faculty Advisor:

Dr. Arnold Burger, Dr. Yunlong Cui, Dr. Mingsheng Guo, Mr. Rastgo Hawrami

Abstract

Through the use of Raman spectroscopy the adsorption of Antifreeze Glycoprotein (AFGP) on hydrophilic mica substrate was studied. Spectrum were taken and compared in different regions of the mica surface. New peaks were discovered at 1354 cm^{-1} , 1507 cm^{-1} and 1511 cm^{-1}.

Structural Evaluation of Carbon Nanotubes on 6H-SiC Substrate

W. Jackson
Department of Physics
Fisk University
1000 17th Ave N
Nashville, TN 37208

Faculty advisors:
Dr. Weiji Lu
Tiffany Crenshaw

Abstract

The defining characteristics of metal free carbon nanotubes are presented in this report. The SiC substrates provided were annealed at 1400°C at 10^{-3} Torr, 1500°C at 10^{-7} Torr, and 1600°C at 10^{-7} Torr. Confirmation of presence of carbon nanotubes was taken through imaging using atomic force microscopy and by using Raman spectroscopy.

Keywords: Carbon Nanotubes, Nanotubes, Silicon Carbide, annealed