

REU 2003 STUDENT ABSTRACTS

Atomic Forces Microscopy of Cadmium Zinc Telluride CZT Crystals

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Abstract

Cadmium Zinc Telluride has been cut, polished and etched and scanned to produce a very fine surface that can be used as a semiconductor in a detector. This crystal was analyzed to see what could be done to better its conductivity.

The Surface Analysis of a CZT Crystal

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Abstract

The CZT crystal is a semiconductor that has the capacity to detect the emission of radiation from radioactive materials. This property of the crystal makes it a good detecting device. The functionality of the crystal could be improved by decreasing the surface leakage currents [1], which is dependent on the crystal's surface smoothness. This reduction of surface leakage current is dependent on the surface smoothness of the crystal. Images of the crystal surface were obtained at different stages of the polishing process that was employed. The images identify the surface as rough and suggest that the polishing process should be improved.

A Study on the Surface Treatment of Cadmium Zinc Telluride (CZT) Nuclear Detectors

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Abstract

A (1 x 1 x 1 cm³) CZT detector was fabricated using different surface preparations polished only and etched in a Bromine-Methanol solution with various concentration-time combinations. Detectors are characterized by Pockels Effect Electric Field Mapping, Mobility-Lifetime Measurements, and Photocurrent vs. Voltage measurements as well as detection performances for each fabrication condition. Each Bromine concentration affected the detector differently but the 1.5% concentration gave the best results on the Current – Voltage and Gamma-Ray spectra by showing the uniformity of the detector.

Keywords: CZT, Etching, Sputtering

Influence of Surface treatment on CZT detector Performances

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Abstract

The Influence of surface treatment in large room temperature CZT detectors is immense. Two large (~1*1*1cm³) CZT detectors are fabricated using a variety of surface preparations-polished only (two grades) and etched in Bromine-Methanol (different concentration-time combinations). Pockel's Effect Electric Field Mapping and Photo Current vs Voltage measurements as well as detection performances for each fabrication condition characterize detectors. Detector performances varied due to the concentration of

etchant used within the experiment. When etched with 1% BM and Methanol the (111) A surface performed well but the b surface did not. The results when etched in a 3% BM solution was very interesting, the B surface seemed to perform better but the surface some how performed worse than before for reasons unknown (possible depletion of Cadmium at different depths on A and B surfaces). The most uniform results came about when the CZT was etched in a 1.5% BM solution at this concentration the detector had a high leakage current, but had the best performance.

Development of Calcium-Phosphate Glass-ceramic Materials

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Abstract

Calcium phosphate glasses heated to form glass-ceramic structures can form structures suitable for protein synthesis or size exclusion chromatography. The purpose for these processes is for enzyme immobilization and research of bioactive glass-ceramics.

Development of Preconcentrator Materials for Explosive Trace Detection

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Abstract

As the magnitude and sophistication of terrorist's activities increase, so must the ability to detect and prevent them. Rapid, accurate, and non-intrusive detection of explosive materials is one essential element for improving and maintaining public safety. Current explosive trace detection technology utilizes a

collection substrate to gather explosive molecules and transport these captured molecules to an ion mobility spectrometer for analysis. Coating this substrate with a material (preconcentrator) that is highly selective in adsorbing explosive molecules would improve the speed and accuracy of the current detection technology. Several potential preconcentrator materials have been systematically evaluated using a quartz crystal microbalance to measure the rate and quantity that certain explosive molecules were adsorbed onto the preconcentrator-coated surface.

Setting up a Computer Lab

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Faculty Advisor: Mr. Harris

Abstract

The ultimate goal in this particular assignment was to set up a completely functioning computer lab for the computer science department. This lab houses its own server, and computer science (cs) student login names, setup specifically for the cs lab only. A room was selected, which accommodated the amount of space needed. The room had two outlets and one network drop. Sufficiently running hardware from the old computer science lab was used for the set up of the new lab.

Keywords: Server 1. Network drop 2.

Development of Novel Porous Glass-Ceramic Materials for Protein Purification and Immobilization

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Abstract

Glass-ceramics are polycrystalline materials prepared by the controlled crystallization of glass. Post-crystallization heat treatment and subsequent acid leaching of certain types of these glass-ceramics can produce porous materials that can be used as matrices for the purification and/or immobilization of biomolecules. Our goal in this project was to investigate the suitability of novel porous glass-ceramics matrices for purification and immobilization of proteins. This research focused initially on the CaO-TiO₂-P₂O₅ system.

Keywords: Glass-Ceramics. Protein Purification. Chromatography.

Analysis of Cadmium Zinc Telluride

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Abstract

CZT (Cadmium Zinc Telluride) crystal helps in the detection of γ - radiation and its properties have to be thoroughly investigated to make a good detector. It has been scanned by the Atomic force microscope after it went through the processes of polishing and etching. The AFM image displayed a rough surface filled with scratches and impurities.

The Surface Morphology of *Bacillus stearothermophilus* under pH stress

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Graduate Assistants:
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Abstract

In the present study, the effect of pH on bacterial cell morphology has been assessed by atomic force microscopy, which allowed for the identification of structural changes that precede spore formation. Using different pHs, and timed optical density reading, the bacteria can be assessed in different pH stresses. Preliminary results show that optimal bacterial growth occurred at pH 8.31, which is more basic than the pH of the growth medium, pH 7.3. Studies of *B. stearothermophilus* and their spore surface morphology will provide a prototype for the structural changes that precede endospore formation in bacteria such as *Bacillus anthracis*.

The Development of Explosive Sensory Materials

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Abstract

In the world today it is there is more concern about everyone safety. The airports, schools, and offices have all added more equipment to help ensure our safety. They have gun, drug, and bomb detectors at every major place. But just because it is there does not mean it could work better. This research me and my lab partner did was to see if we could find a better preconcentrator that would make those systems to work better for detecting bombs. To help the advancement of better working trace detection, to help ensure a safer airports, schools, and offices.

The Surface Morphology of *Bacillus stearothermophilus* under pH stress

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Photoluminescence (PL) Mapping of Cd_{1-x}Zn_xTe

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Abstract

Using a 100 mm x 100 mm Cd_{1-x}Zn_xTe (CZT) wafer as our semiconductor material we used Photoluminescence (PL) to map the zinc concentration of the crystal. Our focus was obtaining a setting and surrounding at room temperature that was conducive in producing optimal PL signal results for better spectra to give us more precise data analysis information. With that data we were able to map key areas on our CZT wafer for zinc concentration, which were compared to SEM readings of zinc concentration at the

same areas. Our spectra developed productively as we evolved into our best experimental setting. Going off the idea that surrounding and setting have a lot to do with the PL signal intensity strength we were pleased with the developing results. Once we reached a comfortable enough experimental setup we were able to map the zinc concentration with data processing, fitting the various spectra with a Peak Finder Program.

Keywords: Photoluminescence (PL), Cadmium Zinc Telluride (CZT)

Growth of Non-catalytic nanotubes on silicon carbide

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Abstract

In the interest of furthering the device fabrication of Silicon carbide it has been decided to try to grow non-catalytic carbon nanotubes on the carbon face surface of a silicon carbide wafer. In order to grow carbon nanotubes on Silicon carbide the 5-8nm by 5-8 nm samples, from a 6h carbon faced 3.5 off axis Silicon carbide wafer, were heated in vacuum at various temperatures. Analysis of the surface was preformed by using Raman spectroscopy to verify nanotube growth. The range of the wavenumbers was from 50-3500cm⁻¹. A mixture of graphite and nanotubes were found on the surface. However, other analysis must be preformed in order to support the data of the Raman spectroscopy.

Keywords: Nanotubes, Non-catalytic, Raman spectroscopy

The Effect of Alpha-methylphenylalanine on the body mass of Phenylketonurial induced rats

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Abstract

Alpha-methylphenylalanine inhibits the PAH enzyme that is developed and located in the liver. When the active site is blocked, the essential amino-acid phenylalanine can't be broken down and therefore builds up. The augmentation of Phen saturates blood flow. This genetic hinderance and disease is known as Phenylketonuria (PKU). Undiagnosed infants with PKU develop mental retardation, because the sensitive growing neurons and hippocampal serotonin receptors are damaged by the increased levels of the amino acid (Phen).

Surface Morphology of Bacteria following Stress Induction

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Ms. Patricia McCarroll

Abstract

In the present study, the effect of temperature on bacterial cell morphology has been assessed by atomic force microscopy. Preliminary results show that in this laboratory it has been revealed that a terminal enlargement and peak elevation that correspond to the spore-forming region. Additionally, it was observed that when temperatures are not optimal, the *B. stearothermophilus* will decrease in size from the normal temperature of 65°C (figure 1). A rough surface analysis was conducted to quantify the observed changes in bacterial cell topography. These photos were taken from freshly cleave mica containing heat fixed and stained *B. stearothermophilus* [methods]. Studies of the *B. stearothermophilus* and their spore surface morphology will give better insight into other endospore forming bacteria such as *Bacillus anthracis*.

Testing and evaluation of Cadmium Zinc Telluride Imager

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Abstract

The focus of our research was on the testing and evaluation of the Cadmium Zinc Telluride (CZT) Imager. We took images from all corners and center of the detector to test which area would produce a better image. Then, using energy cuts we cut certain amounts of energy from the imager to isolate which energy would produce a better image. All of our research was to have a better understanding of the imager, how it works, and how we can improve the images we take with it.

Instrumentation in the Surface Morphology of Stress Induction on Bacillus Stearothermophilus

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Abstract

Bacillus Stearothermophilus is a rod-shaped, thermophilic archaean. Thermophile means heat loving. *B. Stearothermophilus* survives at extreme heat; it's optimal growth temperature range being from 60-65° Celsius. It also thrives in a pH range of 6-8. To survive in these extreme environments it produces certain proteins, or enzymes, that are specially geared to working in high temperatures even as hot as 284°F (140°C). Another method of survival for our sample is sporulation. *B. Stearothermophilus* produces endospores that are capable of surviving some of the harshest conditions. Because of this, the species is able to survive until the time when it can thrive and reproduce.

Optimizing the Signal for Room Temperature PL (Photoluminescence) Systems

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Graduate Students:

Abstract

The following paper will discuss techniques for improving the signal for room temperature PL systems. It will consider theories related to the production and collection of PL. These theories implied that certain changes to the system should be made. The results from the changes are included and evaluated near the end of the paper.

Atomic Forces Microscopy of Cadmium Zinc Telluride CZT Crystals

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Abstract

Cadmium Zinc Telluride has been cut, polished and etched and scanned to produce a very fine surface that can be used as a semiconductor in a detector. This crystal was analyzed to see what could be done to better its conductivity