

Fisk University REU 2007 Abstracts

Screening *Candida guilliermondii* for Biosynthesis of Metal Nanoparticles

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Abstract

The main objective of the undertaken research is to evaluate the potential of various microorganisms for developing nanoparticles. Nanoparticles will definitely play a significant role in technological advancements in the future. A major concern of nanotechnology is to control the chemical composition, shape and size of nanoparticles in a process that is environmentally friendly. This has led to the consideration of biological systems- microorganisms for the biosynthesis of nanoparticles. The long-term objective of the undertaken research is to evaluate the potential of various microorganisms for developing nanoparticles. The human opportunistic fungus, *Candida guilliermondii* (anamorphic yeast) is the major microorganism used in this study. This arm of the project focuses on *Candida albicans* and *Candida guilliermondii*, their nature and morphology and their physical appearance. This was further studied using the Scanning Electron Microscope. Studies showed that *Candida guilliermondii* grew as flat colony yeast cells in Sabouraud Dextrose Agar at 37⁰C and as non-filamentous cells on addition of human serum.

Keywords: *Candida guilliermondii*, Scanning Electron Microscope (SEM), Nanoparticles

Analysis of Initial Growth of Carbon Nanotubes Using Annealed 4H-SiC

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Abstract

Spanning from the original discovery of carbon nanotubes by Sumio Iijima in 1991 (1) researchers have made significant findings for this new form of carbon. They are

molecular-scaled tubes of graphitic carbon with extreme conductivity and durability making them viable materials for development of new materials ranging from metal composite and plastic additives to potential medicinal applications. (2) Due to the relative novelty of CNT's growth exact mechanism for their growth remains unknown. This uncertainty helps foster the direction of further research. Therefore the idea to derive a proposed mechanism for CNT growth generates the concern of investigators. Two samples of heated 4H-SiC (carbon faced) are being investigated using Atomic Force Microscopy to detect the initial features that grow on the annealed SiC wafer. In developing a mechanism proposal we hope to ultimately create better manipulation of CNT growth.

Non-Commercial Photoluminescence mapping system review

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Abstract

The objective of this article is to give a review of the accuracy, construction and operation of a non-commercial room temperature photoluminescence mapping system for the purpose of characterizing the zinc concentration in cadmium zinc tellurium crystals (CZT). This article is not meant to be a review of photoluminescence spectroscopy and therefore will not contain an extensive history of photoluminescence spectroscopy, Raman spectroscopy, infrared spectroscopy, etc. In this article will be covered the experiments used to qualify and quantify different factors of error in the use of a non-commercial photoluminescence mapping system including the comparison with energy dispersion spectroscopy (EDS) results as well as the general construction and operation methods.

Photoluminescence Study of GaTe Crystals

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Abstract

Using a 488nm Laser, incident photons on p-type GaTe crystal resulted in a Photoluminescence (PL) Intensity response. Four measurements were taken at 8.5, 25, 35, and 50K. The experiment was performed at 8.5K such as to include a representation

of the PL intensity from near absolute zero temperatures. Using a graphical data analysis tool a change in peak PL intensity was seen. Also, the resolution of Near Band Gap Energy (NBE) structures and peak PL intensity appeared to a function of temperature. Due to the radiative recombination photons being less than the incident photons ($\approx 2.54\text{eV}$) it is determined that the energy must be compensated for in some energy dispersive mechanism. Radiative recombinations from free excitons (FE), excitons bound to Shallow Level defects (SLD), and deep level defects (DLD) were detected.

Atomic Force Microscopic studies on identification of *Candida albicans*

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Abstract

Atomic force microscopy (AFM) is a type of scanning probe microscopy. AFM is beneficial to use because it is capable of taking images at the atomic level. *Candida albicans* is a fungus that causes oral, genital, and systemic infections in humans. To infect host tissue, the usual unicellular yeast-like form of *Candida albicans* reacts to environmental cues and switches into an invasive, multicellular filamentous form. The objective of this investigation is to develop a rapid and reliable method with atomic force microscopy to replace the conventional time-consuming methods such as culturing the organism in the laboratory and physiological tests for identification of different *Candida* species. Samples were prepared by streaking mica with cultured *Candida albicans* and using Commassie Blue dye on some. The samples were observed under the AFM. The results suggested that what was found may have been clusters of *Candida albicans* cells.

Keywords: *Candida albicans*, Atomic Force Microscopy, morphology

Determination of Hydrogen Bonding in Methanol Aqueous and Deuterium Oxide Solutions Using Raman Spectra

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Abstract

By using Raman Spectra of Polyethylene (CH₂ chain), Polypropylene (CH, CH₂, CH₃) and Polystyrene (CH and CH₂ with a C₆H₅ benzene ring), it was possible to determine the molecular structures of the polymers. Each of the peaks corresponds to a vibrational mode of the molecule under study [1]. In order to study the effects of hydrogen bonding on Methanol, CH₃OH, H₂O was introduced in different concentrations. Changes in the peak positions were observed and were due to the bonding of hydrogen and oxygen causing a stretch in the carbon and oxygen bond due to the hydrophobic and hydrophilic properties present in Methanol [2]. Also deuterium oxide was introduced in different concentrations to methanol. This caused a larger peak change from pure methanol to 90% deuterium oxide and 10% methanol than did H₂O.

The design and implementation of a computer interface for a Raman spectrometer using the LabVIEW software package

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Abstract

A user-friendly computer interface was created for the SPEX 1403 Raman spectrometer using the LabVIEW computer package. The interface allows the user to align the spectrometer easily, produce a graph of the Raman spectra, and save the file to a format readable by a spreadsheet program. The program has three screens: the first allows the user to set initial settings, the second allows the user to read from a particular wavelength for proper alignment, and the third allows the user to set scan settings and perform the scan. The interface was successful in reading Raman spectra easily and efficiently.

Keywords: Raman spectroscopy, LabVIEW, computer interface

Random Lasing Properties of Oxyfluoride Glass-Ceramics with Increased Er³⁺ and Different Heat Treatments

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The purpose of this experiment is to try to produce a random laser using glass-ceramics. Three Erbium doped aluminosilicate glasses of the same composition were prepared with different concentrations of ErF_3 . Each glass was subjected to different heat treatments to allow the glass to crystallize. Absorption scans were run on the first set of glasses to examine the difference between the original glass and the oxyfluoride glass-ceramics (OGCs). Luminescence spectra were obtained for all samples after being illuminated by either a 532 nm frequency doubled Nd:Yag laser or a 488 nm argon ion to determine changes between glasses and OGCs as well as changes between different concentrations of Er^{3+} in each OGC. The glasses showed no definite peaks, however the OGCs showed a sharp peak around 541 nm that decreased with the addition of Er^{3+} . These results show that increasing the erbium concentration in OGCs decreases the crystallization of the glass. It also shows that this particular glass is probably not highly scattering or gain producing enough to harness random lasing action.

Application of AFM and Morphogenesis of *Candida albicans*

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Abstract

Candida is the genus name for the opportunistic fungi often found in humans. In this study we focus our attention on *Candida albicans*. *C. albicans* is known to be dimorphic; it forms a mutualistic relationship under normal conditions and parasitic symbiotic relationship with humans during adverse conditions. At this point *C. albicans* changes from its normal unicellular yeast like form to a multicellular filamentous form, and is known as candidiasis. We will view the changes in this organism using an atomic force microscope (AFM). The AFM is a type of scanning probe microscope capable of capturing images at the atomic level. For this analysis of *Candida albicans* the AFM will allow us to image the cells surface nanostructures and provide us with quantitative height measurements, allowing for a more accurate assessment of the cells dimensions and surface roughness. Finding the images is just a preliminary step in the final goal of our objective. We will be attempting to separate cell clusters into individual cells using chitinase, from which we can study the morphological changes of *Candida albicans* after varying its environmental conditions and applying anti-fungal agents.