Online Proceedings

POSTER SESSION 2

Balcony, Easel 110

12:45 PM to 2:15 PM

Determination of Anisotropic Optical Properties for Single Crystal and Thin-Film β-Ga2O3 using Mueller Matrix Ellipsometry

Jessica Ann (Jessica) Tjalsma, Senior, Materials Science & Engineering, Physics: Comprehensive Physics
Mentor: Marjorie Olmstead, Physics
Mentor: Fumio Ohuchi, Materials Science and Engineering

β-Ga2O3 is a transparent conducting oxide that is well suited to ultraviolet (UV) photovoltaics. One application possibility is as a UV energy harvesting device in space, where UV light is much more abundant than solar. Because of the anisotropy of β-Ga2O3, spectroscopic measurements for a full range of polarization with respect to angles of orientation were taken to obtain optical constants. These measurements were made for both single crystal and thin film samples. As expected, the optical constants vary depending on both the sample type and the orientation of the sample. From these data a model was built that is able to identify the orientation of the single crystal samples. The next step is to build a model that will be used to determine thin film thickness of β-Ga2O3 deposited by our group on different known substrates.

POSTER SESSION 2

MGH 241, Easel 140

12:45 PM to 2:15 PM

Electrical Conductivity Analysis of Graphene Doped with Amino Acids and Self-Assembled Peptides

Richard James (Richard) Boice, Senior, Mat Sci & Engr: Nanosci & Moleculr Engr
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: Fumio Ohuchi, Materials Science and Engineering

This investigation focused on the unique electrical behavior of exfoliated graphene; planar sheets of carbon atoms stripped from bulk graphite flakes. Specifically, the doping effect from self-assembled monolayers (SAMs) on the graphene surface was examined. Previous research has found that certain peptide SAMs are capable of influencing the electrical nature of graphene as both n-type and p-type dopants. This phenomenon can likely aid in development of biosensing and "lab on a chip" technologies. Graphene prepared by the scotch tape method was exposed to chemical solutions of tyrosine (Y) and phenylalanine (F) amino acids. These results are compared with the behavior of similarly deposited GrBP5, a peptide sequence selected for its high binding affinity to graphite. To measure the conductivity and current-voltage profile of graphene doped with each material, graphene field effect transistors (g-FETs) were fabricated on a silicon oxide substrate. Previous research has confirmed GrBP5 is a p-type dopant (electron acceptor). Data collected in this investigation suggests that the tyrosine binding group of GrBP5 is likely the electron acceptor, based on its highly similar doping effect. This p-type nature may be due to the aromatic functional group of tyrosine and would be recommended for future investigation. Furthermore, phenylalanine was found to be an n-type dopant, exhibiting a lower magnitude of doping despite its chemical similarity to tyrosine. By understanding the role of specific amino acids in peptide SAMs for g-FET applications, a large range of peptides may be integrated into this technology, leading eventually to novel biosensing devices.

POSTER SESSION 2

Balcony, Easel 94

12:45 PM to 2:15 PM

Compositional Optimization of Reduced Polycrystalline $Sr_xBa_1 - xNb_2O_6$for High-Temperature Thermoelectric

Kyle Forrest Staples, Senior, Materials Science & Engineering
Mary Gates Scholar
Kimbrelle Shey (Kimbrelle) Thommasson, Fifth Year, Materials Science & Engineering
An H. Dang, Senior, Materials Science & Engineering
Mentor: Fumio Ohuchi, Materials Science and Engineering
Mentor: Christopher Dandeneau, Materials Science and Engineering

For thermoelectric (TE) applications, oxides possess certain advantages over conventional intermetallics, including excellent high-temperature stability, low toxicity, and a complex structure, which aids in lowering the thermal conductivity. Recently, it has been found that SrxBa1-xNb2O6 (SBN) holds potential for use in high-temperature TE applications (e.g., waste heat recovery). In our work, a solution combus-

tion synthesis (SCS) process was devised to fabricate SBN with a range of Sr:Ba ratios in order to ascertain an ideal SBN composition for optimum TE behavior. The SCS method, which is highly amenable to mass production, allowed for good control of the SBN stoichiometry, and the as-processed powders were found to possess good single phase purity. Powders processed with different SBN compositions were subject to conventional sintering followed by reduction. The TE properties of each SBN composition were then tested and compared. Preliminary results of our acquired data suggest a decrease in the thermal conductivity as the Ba content is increased, likely due to the larger mass of Ba when compared to Sr. From the obtained results, an ideal SBN composition was determined having the optimal TE performance. Field assisted sintering (FAST) was then employed to processed SBN powder having the optimum composition, and the TE properties of the SBN from both conventional sintering and FAST were compared.