**Toward Graphene-Based Imaging and Drug-Delivery Agents for Breast Cancer: Cytotoxicity of Graphene Oxide Nanoribbons in Human Breast Cancer Cell Lines**

Kayla Neville*, Jeong Yun Yang*, Sayan Mullick Chowdhury, Pramod Avti, Balaji Sitharaman, *Multi Functional Nano & Supra Molecular Biosystems Laboratory, 115 Bioengineering, State University of New York at Stony Brook, Stony Brook, NY 11794-5281*

**Background:** Over the course of two months, we had the opportunity to conduct science research in the Multi Functional Nano & Supra Molecular Biosystems Laboratory at SUNY Stony Brook through the Students and Scientists High School Internship Program sponsored by the Huntington Breast Cancer Action Coalition, Inc. and the Great Neck Breast Cancer Coalition.

**Objective:** The aim of this internship was to give students the unique opportunity to engage in authentic science research. The focus of the research was to study the cytotoxicity of graphene oxide nanoribbons on human breast cancer cell lines MCF-7 and SkBr.

**Work performed:** To accomplish the objective the effects of different dilutions of graphene oxide nanoribbons on the different functions of MCF-7 and SkBr breast cancer cells were investigated. Graphene oxide nanoribbons are a type of carbon-based nanoparticle that has potential to revolutionize the field of nanomedicine. These nanoparticles are currently being explored for their potential medical applications, such

as multi-functional platforms for molecular imaging of breast cancer tumors and targeted drug-delivery agents to improve the accuracy and efficiency of breast cancer treatment. Before these nanoribbons can be used for biomedical applications, their toxicity needs to be evaluated. Thus, as a first step, *in vitro* cytotoxicity studies have been conducted to determine to identify their $CD_{50}$ value, i.e. the concentration of graphene oxide nanoribbons at which half of the initial cells remain viable. The cytotoxicity was determined through the use of four colorimetric assays: Neutral red, Alamar Blue, Lactic dehydrogenase (LDH), and the Water Soluble Tetrazolium-1 (WST-1) assay. To further validate the assessment, a non-colorimetric assay was also used. There were 6 trials conducted for each concentration of 0, 1, 10, 50, 100, 250, 400, and 500 μg GONR /mL DSPE-PEG. Our results show that the $CD_{50}$ value of the graphene nanoribbons was between 100 and 250 μg/mL. Preliminary investigations also show that concentrations of less than 50 μg/mL do not affect the cell machinery, and that these dosages maybe be safe for the *in vitro* studies to test their efficacy as imaging and drug delivery agents.

**Conclusions:** Through this experience, we gained an understanding of the research process and the importance of cytotoxicity studies before a product can be used for biomedical applications, such as drug delivery and medical imaging contrast agents. Our results showed that the $CD_{50}$ value was 100 μg/ml of graphene oxide nanoribbons after 48 hours of exposure. This preliminary research is necessary to lower the likelihood of negative side effects when these nanoparticles are studied further as multi-functional platforms for molecular imaging of breast cancer tumors and targeted drug-delivery agents to improve the accuracy and efficiency of breast cancer treatment.