WRIGHT STATE UNIVERSITY | BIOMEDICAL SCIENCES PhD PROGRAM

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DISSERTATION DEFENSE

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"CARBON NANOTUBE-COATED SCAFFOLDS FOR TISSUE ENGINEERING APPLICATIONS"

Wednesday, April 21st, 2021

11:00 am

Webex: https://wright.webex.com/meet/courtney.sulentic

Advisor: Sharmila Mukhopadhyay, PhD
University of Maine

Soham Parikh, Biomedical Sciences PhD Program
Wright State University, 2021

Carbon Nanotubes (CNTs) have beneficial properties for cell scaffolding, which has translated into effective growth of bone, muscle, and cardiac cells. However, loose carbon nanotubes (CNTs) can cause *in vivo* toxicity. To reduce this risk, our team has developed biomimetic scaffolds with multiscale hierarchy where carpet-like CNT arrays are covalently bonded to larger biocompatible substrates. In this study, we have tested the use of such scaffolds in two distinct types of biomedical applications involving glioblastoma and keratinocyte cells.

The growth of glioblastoma (GBM) cells on our CNT-coated biomimetic scaffolds was evaluated to check their suitability as a potential chemotherapy-loaded implant for GBM patient treatment. We utilized CNT carpets on flat carbon fiber cloths and porous carbon foams and identified differing effects on cell growth by altering the surface hydrophilicity. Synthesized CNT-coating is naturally superhydrophobic and prevents GBM cell growth initially, but over time cell proliferation increases to normal levels. When the CNT surface was modified to be hydrophilic, the GBM cells followed a normal growth curve. These findings support the feasibility of developing a CNT-coated chemotherapy-loaded implant for post-surgical resection in GBM patients.

Keratinocyte cell growth on CNT-coated carbon fiber cloth was investigated to assess its compatibility as a skin graft material for wound healing applications. Due to its covalently linked structure, biocompatibility, functionalizable topological features, and extensive surface area, CNTs could provide a suitable surface for skin cell proliferation. CNTs can also provide directionality, which can be important for supporting scaffolds used in wound healing applications. This project aimed to determine whether the use of CNTs attached to carbon scaffolds are capable of sustaining keratinocyte growth for future development of novel skin graft development. Studies demonstrated biocompatibility for keratinocyte growth as shown by cell proliferation, cell migration, and cytotoxicity analysis. Moreover, the CNT-coated carbon scaffolds provided cytoprotection against environmental stressors such as Ultraviolet-B rays. We also found that keratinocyte cell growth can be tailored through the length of CNT coating and wettability control. These results point to the benefits of designing CNT-coated scaffolds for strategic wound healing applications. Together, these results strongly support the future potential of these bio-mimetic scaffolds in tissue engineering.