DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering
PhD Thesis Proposal

Monday, November 18, 2019, 10 am
MEM Seminar Room, 162 Curtis Hall

Multiscale Integration of Two-Dimensional Transition Metal Carbides (MXenes) into Wearable Functional Textiles

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In recent years, significant efforts have been made in the development of wearable technologies by integrating functional materials into fiber-, yarn-, and fabric-devices. Two-dimensional (2D) transition metal carbides, such as Ti_3C_2 MXenes, are promising candidates for achieving the next generation of functional textile-based devices, offering high specific surface area, metallic conductivity, excellent mechanical properties, high electrochemical activity, and chemical stability.

The goal of this PhD thesis study is to develop MXene-enabled functional fibers/yarns by utilizing MXene inks to assess and control physical, chemical, and functional properties of produced fibers/yarns, as well as to design and manufacture MXene containing textile-based devices. This thesis will provide insights into identifying how MXene ink parameters affect the textile processing techniques to fabricate multifunctional, wearable devices. More specifically, a framework that governs parameters such as MXene flake size, ink concentration, and the manufacturing techniques to produce fiber-, yarn-, and textile-based devices will be established. Influence of these parameters on both electrical conductivity and electrochemical properties with a specific focus on scalability and washability will be investigated. In addition to the study of fundamental aspects of the MXene ink formulation, by using the established framework, guidelines that can help design multifunctional fiber-, yarn-, and fabric-devices with desired properties will be generated. Outcomes of the proposed work will bridge a critical gap between 2D nanomaterial synthesis and textile communities that is necessary to develop better performing wearable devices not only for energy storage applications but also for an ever-growing smart textile systems field that has found many applications including but not limited to antennas, energy harvesting, sensing and so on.