DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering,
Ph.D. Thesis Proposal

High Energy Delaminated MXene for Future Technology Applications

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Abstract

MXenes, a family of two-dimensional (2D) materials have shown considerable promise in a wide range of applications from energy storage to electromagnetic interference shielding. Due in part to MXenes dispersion in water rheological properties MXenes can be made into inks and be used in a variety of deposition techniques to create multifunctional coatings that can aid in the realization of future technologies. While MXenes have shown promise in these fields there still exist bottlenecks in the production process. To take advantage of many of the properties of MXene multilayer MXene must then be delaminated into single flakes in stable aqueous dispersions that can act as functional inks. The current state of the art for delamination of MXene incorporates cationic chemical species between individual flakes that expands the interlayer spacing and allows for delamination. This delamination process is time and waste intensive and leads to MXene with chemical impurities that can affect the final application. Particularly, lithium impurities make MXene undesirable in biological applications. Herein, we propose to generate MXene inks with high-energy methods without the use of chemical intercalants. We will extend this procedure to generate stable MXene dispersions with scalable methods that generate nearly zero waste. Finally, we will demonstrate that MXenes made this way can be made into inks with various rheological properties for use in the additive manufacture of electronics for future technologies, specifically, we will incorporate these inks into smart food packaging and textile-based electronics capable of energy harvesting and energy storage with a single functional material, MXene.