DREXEL UNIVERSITY
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High throughput MXene delamination for powering e-textile devices

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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 to the rheological properties of aqueous MXene dispersions, MXenes can be made into inks and can be used with 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 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 expand the interlayer spacing and allow 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 look at MXenes in e-textiles. Demonstrating that MXenes can be used for textile-based energy storage applications capable of powering real-world electronics that can perform environmental sensing and data transmission. We extend the idea of powering garments beyond energy storage to produce printed MXene induction coils (MX-coils). We print these MX-coils directly onto textile substrates and show that they can transfer power into a textile to charge an MXene-textile supercapacitor, direct applications, and joule heating. The MX-coils show substantial mechanical robustness and can even be used as transmitter coils to transfer power and data off a garment