MXene Synthesis Using Lewis Acidic Etching for Li-Ion Battery Applications

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MXenes are a 2D nanomaterial typically synthesized using hydrofluoric acid (HF) etching, a process that is time-consuming, unsafe for workers, and environmentally detrimental. A method developed using Lewis Acids can achieve competitive results to the HF-etched results in a more time-efficient and safe manner. The MAX phase powder Ti3SiC2 was grounded with etchants copper II chloride, sodium chloride, and potassium chloride. The mixture was placed in a tube furnace at 750°C, then cleaned with DI water and 0.1 M APS solutions. The obtained MXenes were dried in a vacuum oven and constructed into anode material for testing lithium-ion batteries. Data was analyzed using XRD, goniometers, 3D imaging, and cycle performance tests. The produced MXene Ti3C2Tx formed a thin, but viable ink retaining ceramic-like qualities. The IF tension of the material is 48.2 dynes/cm and the contact angle is 37.0o. The applied laser-patterned battery type has up to a 97% capacity retainment rate, while the bar-coated cell has a 75% retainment rate. This study showed that Lewis Acidic Etching produced viable MXenes that can compete with HF-etched results. Further experiments will test the battery capacity retainment rates under various conditions and the MXenes will be used for a biomedical sensor.