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Effect of Etching Process on the Tribological Properties of 2D $Ti_3C_2T_x$ MXenes

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Extended Abstract

MXenes are a relatively new group of materials compared to other 2D materials. Ever since its discovery in 2011 [1], MXenes have been used in various applications such as electromagnetic shielding, energy storage, tribology, structural materials, and biological applications [2]. The primary objective of this work would be to study the tribological properties of $Ti_3C_2T_x$ 2D MXene sheets in relation to different etching processes. Etching is a process within the overall synthesis process of MXenes to turn the precursor MAX phase Ti_3AlC_2 into exfoliated MXene sheets by removing the Al layer and adding the termination species T_x, depending on the etching process [2]-[4]. HF acid has been the most common method in etching the Ti_3AlC_2 to turn into $Ti_3C_2T_x$ 2D MXene sheets, as it produces high quality 2D layers [5]. However, due to the toxicity of HF, other methods should also be explored that are more environmentally friendly. Therefore, the tribological properties of $Ti_3C_2T_x$ 2D MXene sheets between different etching methods should be determined and compared. To study the differences between etching processes, different types of $Ti_3C_2T_x$ MXene powders, using wet chemical process with NaF salt to etch Ti_3AlC_2, were dispersed and then tested using frictional force microscopy (FFM). The friction properties of $Ti_3C_2T_x$ MXene 2D layers etched with wet chemical process with NaF salt would be compared to that of $Ti_3C_2T_x$ etched with HF acid. The powders were then dispersed in DI water with concentrations of 1.5 to 1.65 mg of $Ti_3C_2T_x$ to 1 mL DI water. The mixtures were then drop casted on SiO_2 substrates and then left to dry. Through this method, $Ti_3C_2T_x$ flakes, etched with NaF salt, of around 2-3 nm thick has been found, yet the flake size was much smaller compared to the same flakes from HF acid etched MXenes. The FFM experiments were conducted on the $Ti_3C_2T_x$ 2D MXene layers and were compared with MXene etched with HF acid and other 2D materials.

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