High capacity $Ti_3C_2T_x$ MXene electrodes achieved by co-solvent system for supercapacitor

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Abstract

MXene, a two-dimensional transition metal carbide or nitride, has emerged as a promising material for use as a Supercapacitor(SC) electrode in recent years. Unlike conventional batteries, which store energy through a chemical reaction, SCs store energy through the separation of charge at the electrode/electrolyte interface. Therefore, Synthesis of layered transition metal carbides exhibiting a mesoporous structure remains challenging [1], but nonetheless is useful because it turns such solids into functional materials with a high specific surface area. However, hydrogen bonds between water molecules and oxygen terminal groups on the surface are formed in aqueous solution processes, and this is a decisive factor in reducing the surface area [2]. Herein, we develop an extraction method to remove intercalated water molecules using a simple intermolecular force attraction strategy in a co-solvent system with a combination of polar-protic/aprotic and non-polar solvents and as a result self-aggregated mesoporous $Ti_3C_2T_x$ has been realized without any additives (Figure 1). Finally, electrodes made with MXene showed a higher specific capacitance of 224 F/g at 1 A/g with high stability (96.5%@10,000 cycles). This intermolecular attraction-induced, approach involving manipulation of the morphology is facile and scalable and could prove important in electrochemical MXene-based applications.

References

[1] Natu, Varun, et al. *Materials Research Letters* 6 (2018) 230.
[2] Y. Yoon, et al. *Advanced materials* 25 (2013) 4437

Figures

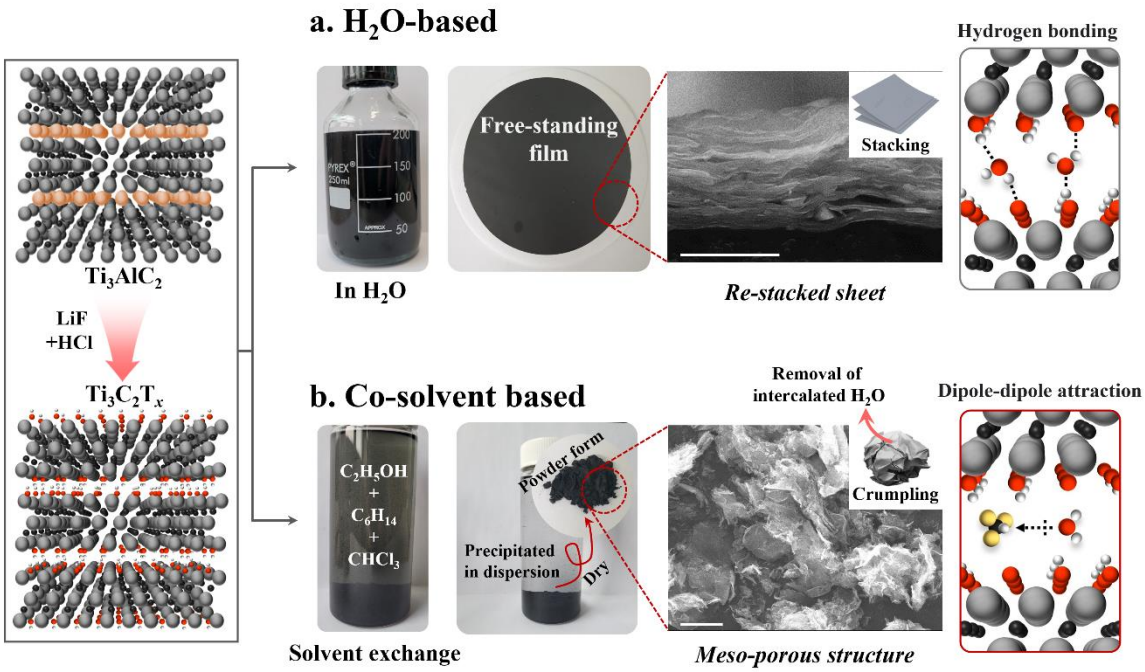

Figure 1: Schematic illustration of formation for crumpled $Ti_3C_2T_x$.