Lithium Intercalation into MXene with Hydrate Melt Electrolyte

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The development of high-performance electrolytes achieving efficient ion transport,[1] a wide electrochemical window,[2] low cost, and safety[3] is an imperative need for electrochemical energy storage devices. Recently, our group developed a superconcentrated aqueous electrolyte ($Li(TFSI)_{0.7}(BETI)_{0.3}\cdot 2H_2O$, a hydrate melt electrolyte) that operates with a wide electrochemical window over 3 V.[4] We applied this to titanium carbide MXene Ti_2CT_x (Fig. 1a) electrode toward new-type of battery system. MXenes are emerging two-dimensional electrode materials (a general forumla of $M_{n+1}X_nT_x$, M = Ti, Nb, Mo, V, etc., X = C, N, T_x = OH, O, F, Cl) that exhibit facile intercalation of various guest ions.[5, 6]

Ti_2CT_x in a conventional aqueous electrolyte (1.0 M Li_2SO_4/H_2O) exhibits capacitive behavior to give a specific capacitance of 158 F/g with a narrow electrochemical window of 0.4 V (Fig. 1b). However, using the hydrate melt electrolyte, the specific capacitance increases to 168 F/g with a wide electrochemical window of 1.1 V. The effect of the Li-ion hydration structure will be discussed in detail using structural, electrochemical, and spectroscopic analysis.

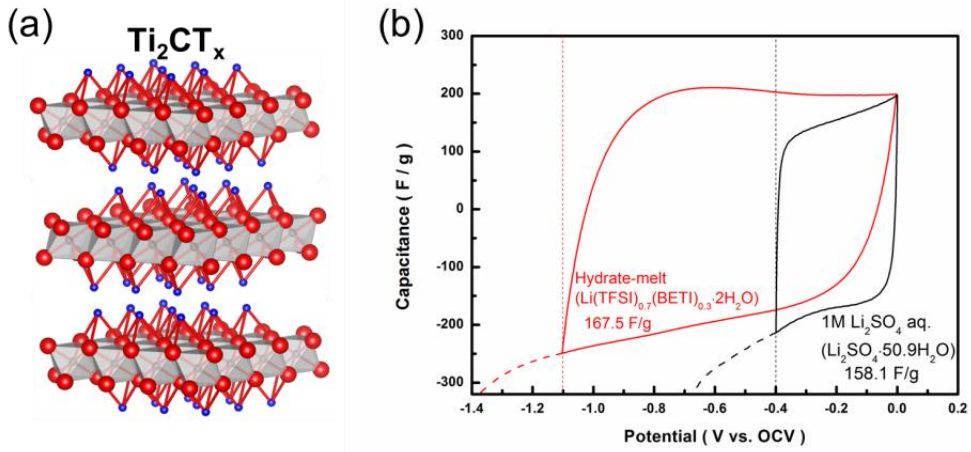

Figure 1. (a) Schematic illustration of MXene Ti_2CT_x and (b) CV curves of MXene Ti_2CT_x with 1.0 M Li_2SO_4 aq. and hydrate-melt electrolytes at a 0.5 mV s^{-1} sweep rate.

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