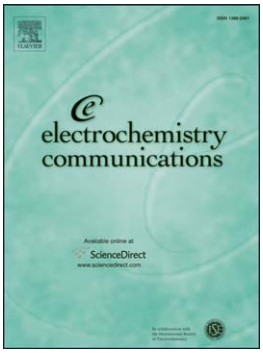

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ABSTRACT

2D titanium carbide ($Ti_3C_2T_x$ MXene) showed good capacitance in both organic and neat ionic liquid electrolytes, but its charge storage mechanism is still not fully understood. Here, electrochemical characteristics of $Ti_3C_2T_x$ electrode were studied in neat EMI-TFSI electrolyte. A capacitive behavior was observed within a large electrochemical potential range (from -1.5 to 1.5 V vs. Ag). Intercalation and de-intercalation of EMI^+ cations and/or $TFSI^-$ anions were investigated by *in-situ* X-ray diffraction test. Interlayer spacing of $Ti_3C_2T_x$ flakes decreases during positive polarization, which can be ascribed to either electrostatic attraction effect between intercalated $TFSI^-$ anions and positively charged $Ti_3C_2T_x$ nanosheets or steric effect caused by de-intercalation of EMI^+ cations. The expansion of interlayer spacing when polarized to negative potentials is explained by steric effect of cations intercalation.

Keywords: supercapacitor; Ti_3C_2; *in-situ* XRD; ionic liquid; MXene; 2D carbide