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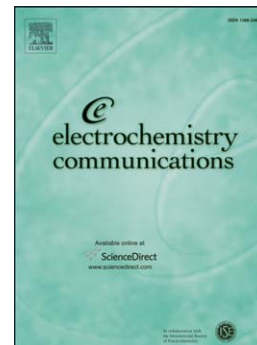
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# Electrochemical and *In-situ* X-ray diffraction Studies of $\text{Ti}_3\text{C}_2\text{T}_x$ MXene in Ionic Liquid Electrolyte

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## ABSTRACT

2D titanium carbide ( $\text{Ti}_3\text{C}_2\text{T}_x$  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  $\text{Ti}_3\text{C}_2\text{T}_x$  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  $\text{EMI}^+$  cations and/or  $\text{TFSI}^-$  anions were investigated by *in-situ* X-ray diffraction test. Interlayer spacing of  $\text{Ti}_3\text{C}_2\text{T}_x$  flakes decreases during positive polarization, which can be ascribed to either electrostatic attraction effect between intercalated TFSI<sup>-</sup> anions and positively charged  $\text{Ti}_3\text{C}_2\text{T}_x$  nanosheets or steric effect caused by de-intercalation of  $\text{EMI}^+$  cations. The expansion of interlayer spacing when polarized to negative potentials is explained by steric effect of cations intercalation.

**Keywords:** supercapacitor;  $\text{Ti}_3\text{C}_2$ ; *in-situ* XRD; ionic liquid; MXene; 2D carbide

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