

## SUPPLEMENTARY INFORMATION

### Investigation and Development of Photocathodes using Polyaniline Encapsulated $\text{Ti}_3\text{C}_2\text{T}_x$ MXene Nanosheets for Dye-sensitized Solar Cells

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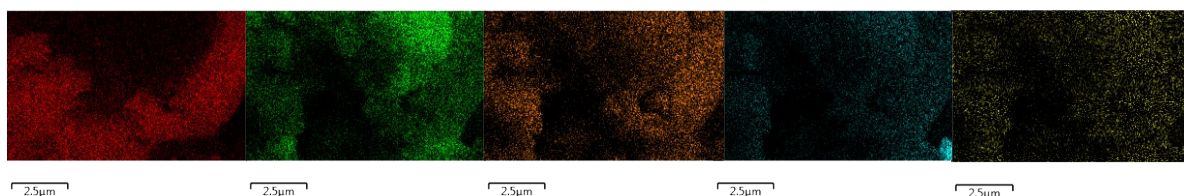
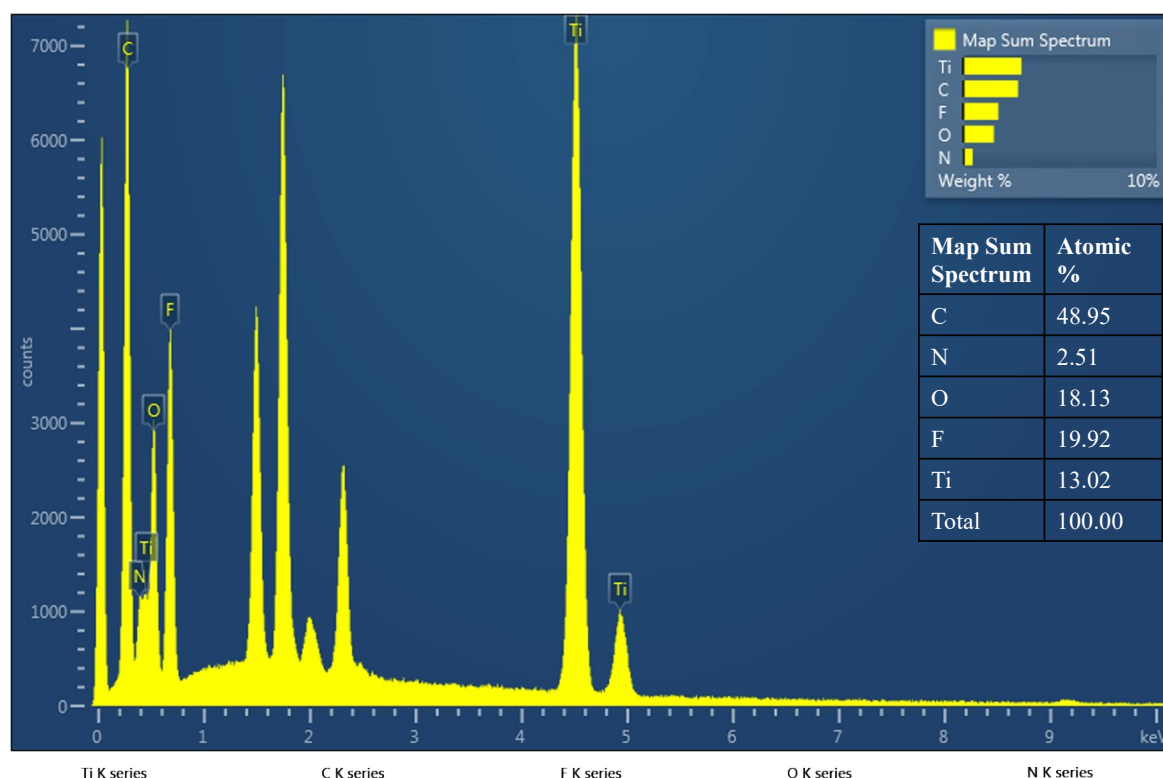


Fig. S1 EDS and elemental mapping of PANI-Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> hybrid

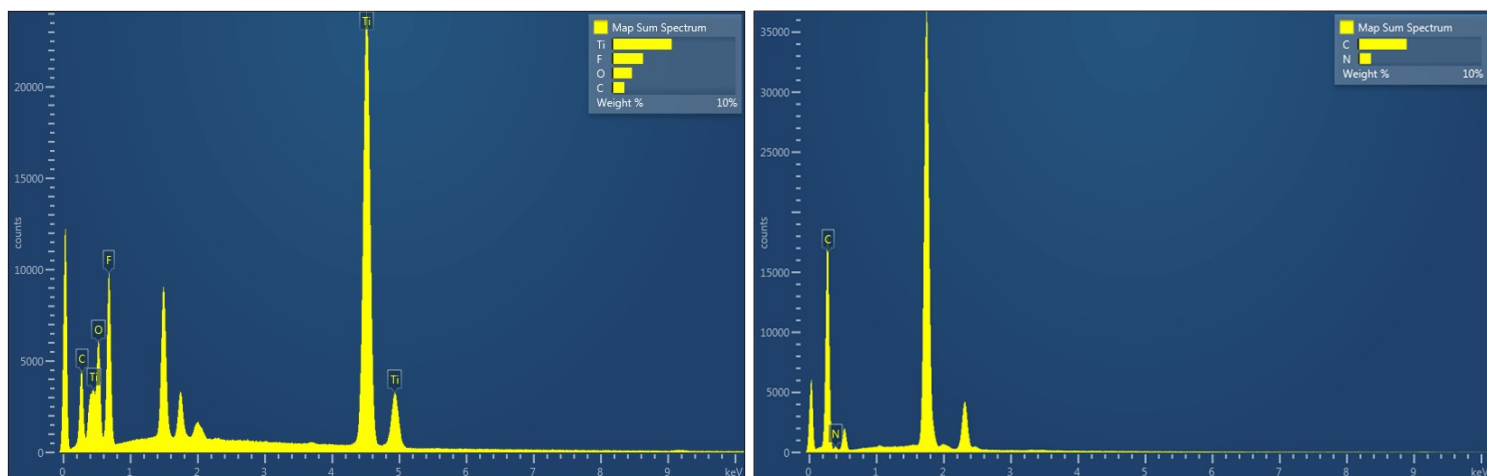


Fig. S2 EDS spectrum of pristine Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> and PANI

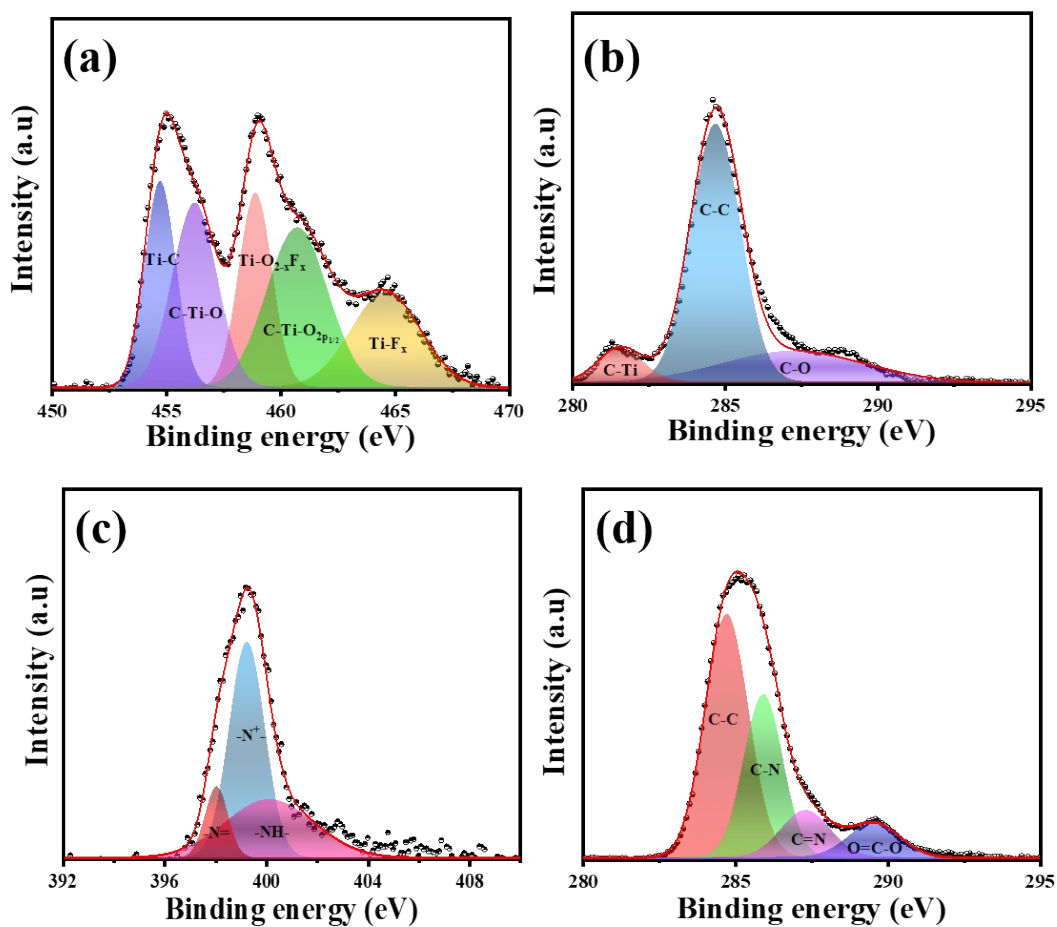


Fig. S3 XPS patterns of (a) and (b)  $Ti_3C_2T_x$  and (c) and (d) PANI

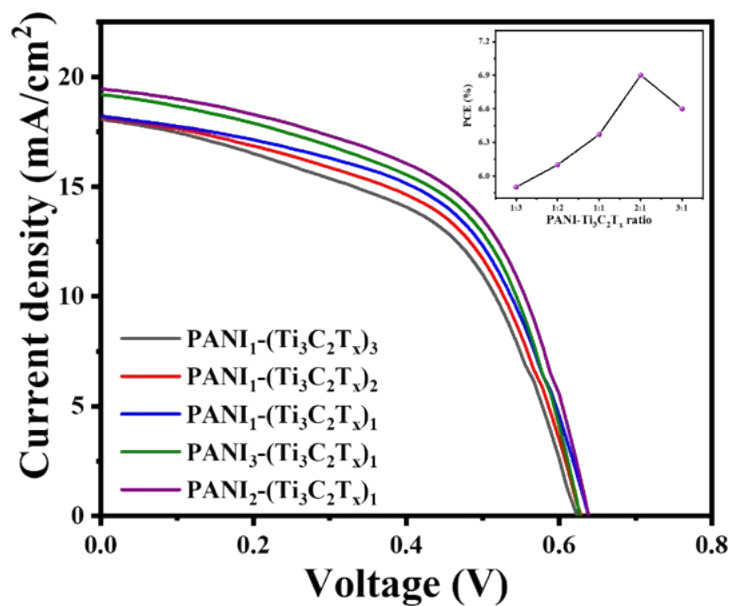


Fig. S4 Comparison I-V characteristics of PANI to  $Ti_3C_2T_x$  ratios

Table S1 Comparison table of the photovoltaic performance of PANI to  $Ti_3C_2T_x$  ratios

PANI- $Ti_3C_2T_x$ ratios	$V_{oc}$ (V)	$J_{sc}$ (mA/cm <sup>2</sup> )	Fill factor	$\eta$
1:3	0.62	18.1	52	5.9
1:2	0.63	18.2	54	6.1
1:1	0.64	18.3	55	6.4
2:1	<b>0.64</b>	<b>19.4</b>	<b>55</b>	<b>6.9</b>
3:1	0.63	19.2	55	6.6

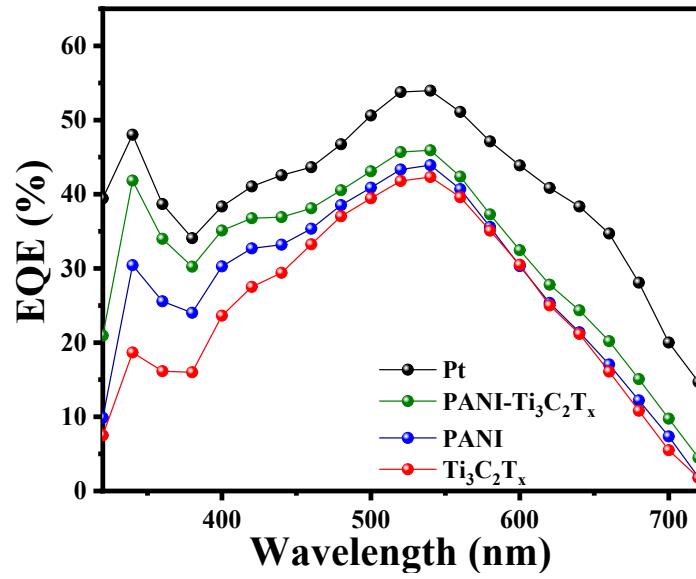


Fig. S5 EQE of DSSCs with various CEs

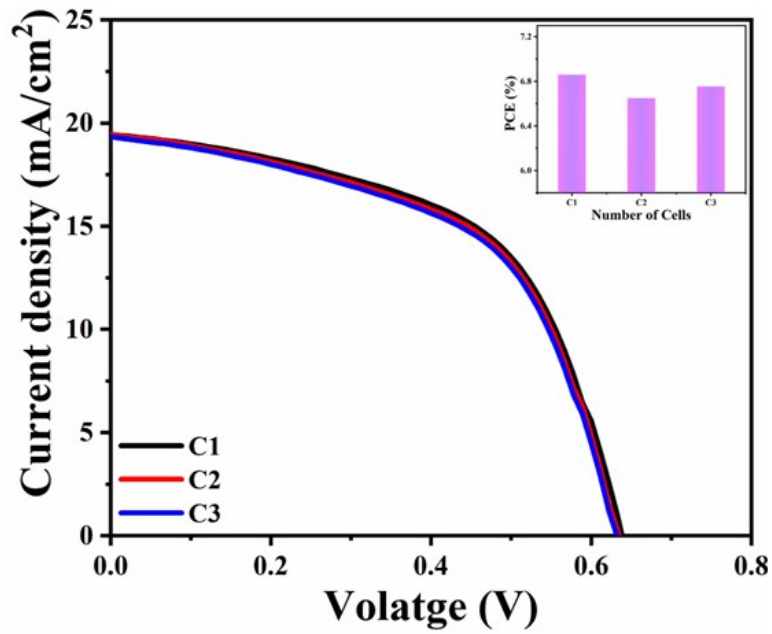


Fig. S6 Reproducibility test of DSSC fabricated with PANI-Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> CE