Title: MXene-enhanced perovskite solar cells: Unveiling the superior performance of Mo_2TiC_2 as an advanced electron transport layer

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Abstract: The perovskite solar cell (PSC) is a leading contender in the contemporary thin-film solar industry due to its low cost, flexibility, superior performance in low-light conditions, and exceptional efficiency. This study concentrates on the construction of an optimally performing perovskite solar structure ($CsSnI_3$, $FASnI_3$, $MASnI_3$, and $MAPbI_3$) utilizing highly efficient Mo_2TiC_2-MXene material as the electron transport layer (ETL), employing the numerical simulator SCAPS-1D. We methodically analyze the effects of variations in layer thickness, defect density, donor density, and acceptor density to find the optimal performance of solar structures. Consequently, the structure of FTO/Mo_2TiC_2-MXene/$CsSnI_3$/Spiro-OMeTAD/Au has shown an excellent electrical performance with V_{OC}, J_{SC}, FF, and PCE of 0.9526 V, 34.189 mA/cm^2, 86.65%, and 28.22%, respectively. The J-V characteristics and optical performance indicator, i.e., quantum efficiency, are also examined carefully. Additionally, stability analysis evaluates the effects of shunt resistance, series resistance, and temperature of the corresponding cells. Furthermore, the compatibility of MXene materials with perovskite absorber and their corresponding stability analysis has been performed to unwrap the full potential of Mo_2TiC_2-MXene as an ETL.

Keywords: MXene, Thickness, Defect, PCE, Optimized

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