Enhancing the Stability of Perovskite Light-Emitting Diodes Based on Cl-MXene

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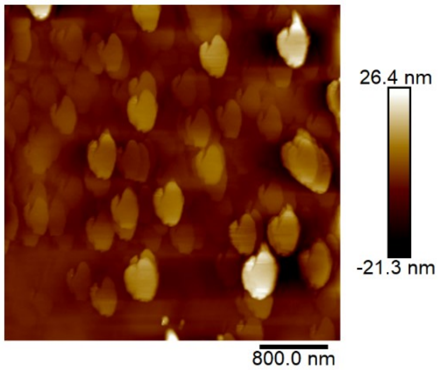

Figure.S1 Atomic Force Microscopy (AFM) image of the distribution of MXene on ITO.

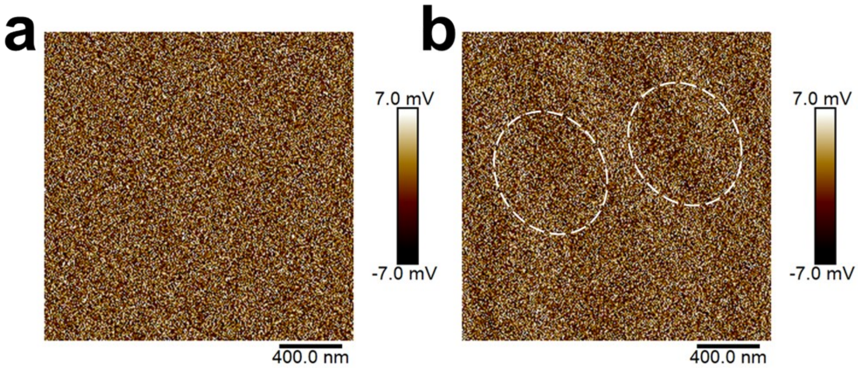

Figure.S2 The potential distribution of the bottom surface (a) without and (b) with MXene substrates.

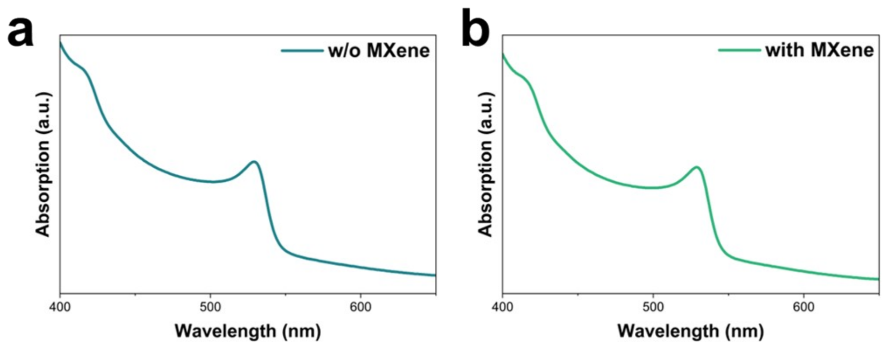

Figure.S3 Ultraviolet-visible absorption spectra of perovskite films (a) without and (b) with MXene interface layers.

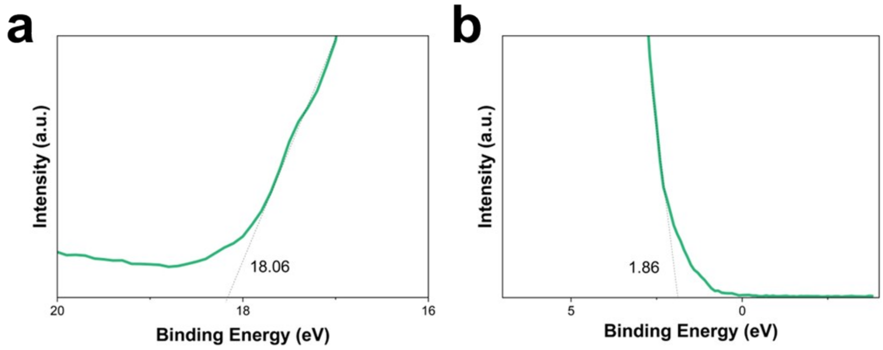

Figure.S4 The Ultraviolet photoelectron spectroscopy of the MXene layer.

References:

1 Xing S, Lian Y, Lai R, Cao X, Yu M, Zhang G, et al. Tuning Precursor-Amine Interactions for Light-Emitting Lead Bromide Perovskites. J Phys Chem Lett. 2022;13(2):704–10.

2 Cai X, Xu Y, Pan Y, Li L, Pu Y, Zhuang X, et al. Solution-Processable Pure-Red Multiple Resonance-induced Thermally Activated Delayed Fluorescence Emitter for Organic Light-Emitting Diode with External Quantum Efficiency over 20. Angew Chem Int Ed Engl. 2023;62(7):e202216473.

3 Di D, Romanov AS, Yang L, Richter JM, Rivett JP, Jones S, et al. High-performance light-emitting diodes based on carbene-metal-amides. Science. 2017;356(6334):159–63.

4 Yang D, Zhang G, Lai R, Cheng Y, Lian Y, Rao M, et al. Germanium-lead perovskite light-emitting diodes. Nat Commun. 2021;12(1):4295.

5 Kim JS, Heo JM, Park GS, Woo SJ, Cho C, Yun HJ, et al. Ultra-bright, efficient and stable perovskite light-emitting diodes. Nature. 2022;611(7937):688–94.

6 Liu Z, Qiu W, Peng X, Sun G, Liu X, Liu D, et al. Perovskite Light-Emitting Diodes with EQE Exceeding 28% through a Synergetic Dual-Additive Strategy for Defect Passivation and Nanostructure Regulation. Adv Mater. 2021;33(43):e2103268.

7 Lin K, Xing J, Quan LN, de Arquer FPG, Gong X, Lu J, et al. Perovskite light-emitting diodes with external quantum efficiency exceeding 20 per cent. Nature. 2018;562(7726):245–8.

8 Persson I, Halim J, Lind H, Hansen TW, Wagner JB, Naslund LA, et al. 2D Transition Metal Carbides (MXenes) for Carbon Capture. Adv Mater. 2019;31(2):e1805472.

9 Li M, Han MK, Zhou J, Deng QH, Zhou XB, Xue JM, et al. Novel Scale-Like Structures of Graphite/TiC/Ti_3C_2 Hybrids for Electromagnetic Absorption. Adv Electron Mater. 2018;4(5).