Electronic Supplementary Information (ESI)

All-MXene (2D titanium carbide) solid-state microsupercapacitors for on-chip energy storage

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Areal cell capacitance (C_{areal}) was calculated from the CV curves according to the following equations.

Areal capacitance (C_{areal}) = ($\int IdV$)/(sVA)   (2-electrode configuration).

Where I is the current, 's' is the scan rate, V is the potential window, and A is total area of both the electrodes.

Volumetric capacitance was calculated from the CV and charge-discharge curves, respectively.

Volumetric capacitance $(C_{vol}) = (\int IdV)/(sVv_t)$ and $(i/v_t)(\Delta t/V)$

Where v_t is the total volume of both the electrodes, 'i' is the applied current, and Δt is the discharge time.

Energy density $(E) = (1/7200)*C_{vol}V^2$ (Wh cm^{-3})

Power density $(P) = (E*3600)/\Delta t$ (in W cm^{-3}).

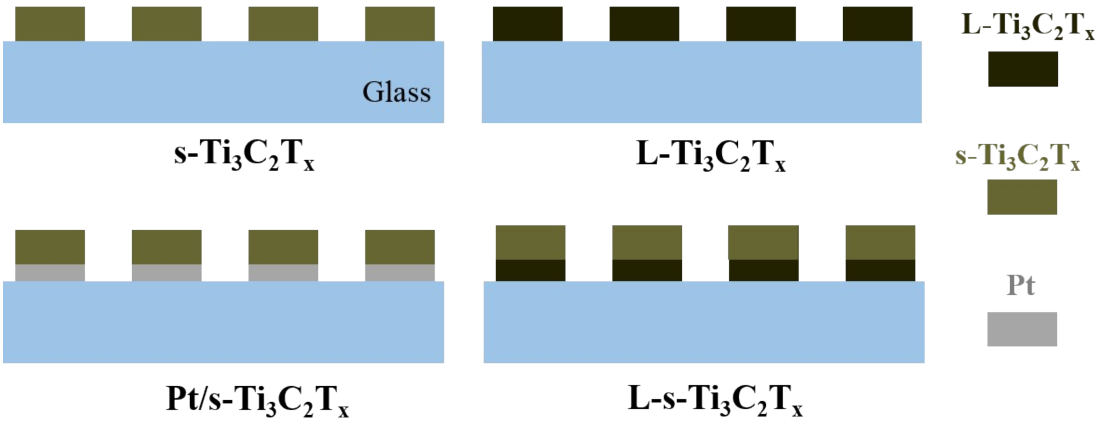

Fig. S1 Schematic illustrations showing the side view of s-$Ti_3C_2T_x$, L-$Ti_3C_2T_x$, Pt/s-$Ti_3C_2T_x$, and L-s-$Ti_3C_2T_x$ MSCs.

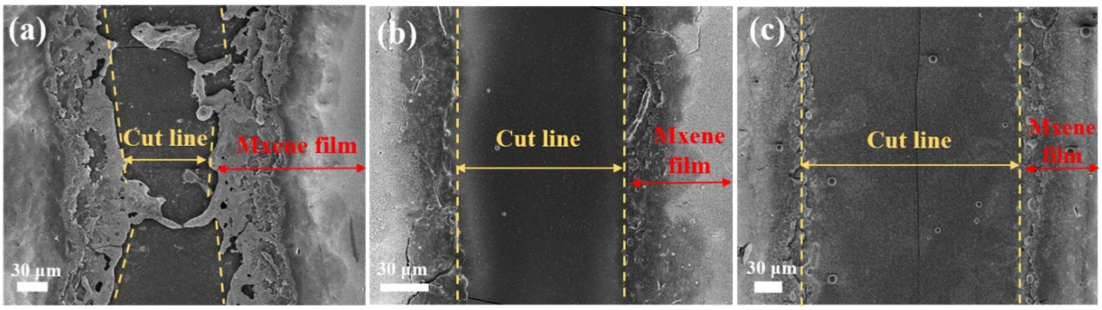

Fig. S2 Optimization of laser processing for obtaining clean separation between fingers. (a) Impartial cut of the film when using the power setting less than 2%, electrical shorts are obvious. (b) A straight and clean interspace was obtained using power setting between of 4 to 5%. However, the width of the channel is gradually increased at a higher power of 10%, as shown in Fig. S1(c). Therefore, an optimal laser power was used to define the clean separation while having the minimum possible space between the fingers.

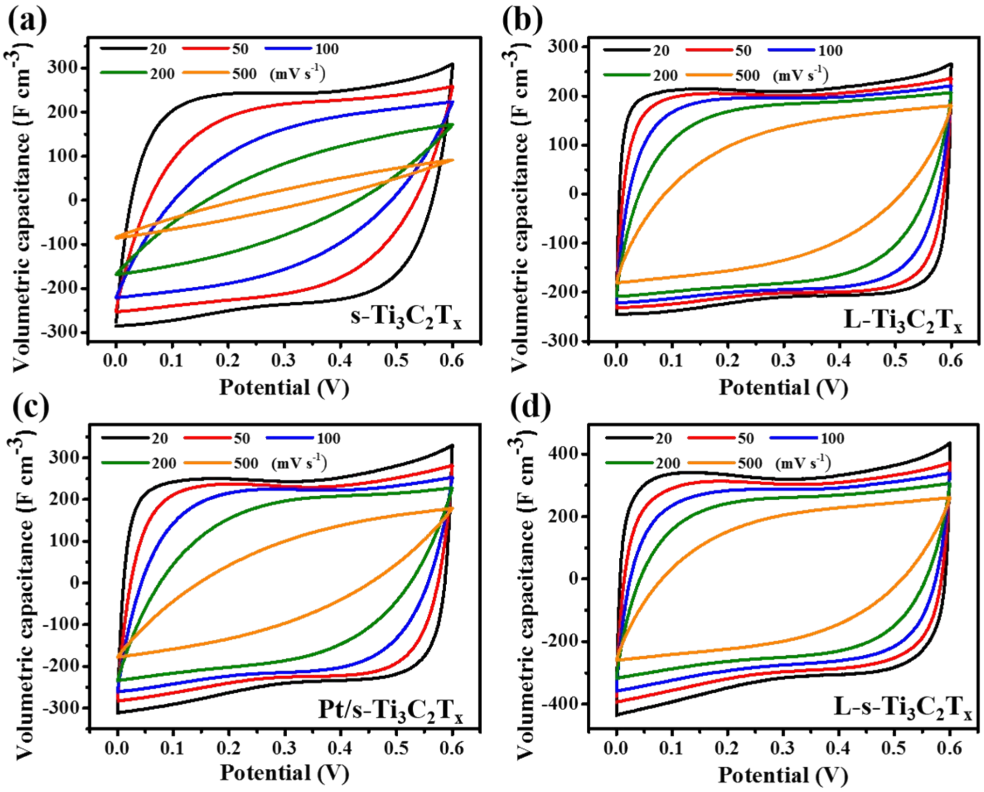

Fig. S3 CV curves of (a) s-$Ti_3C_2T_x$, (b) L-$Ti_3C_2T_x$, (c) Pt/s-$Ti_3C_2T_x$, and (d) L-s-$Ti_3C_2T_x$ MSCs at different scan rates.

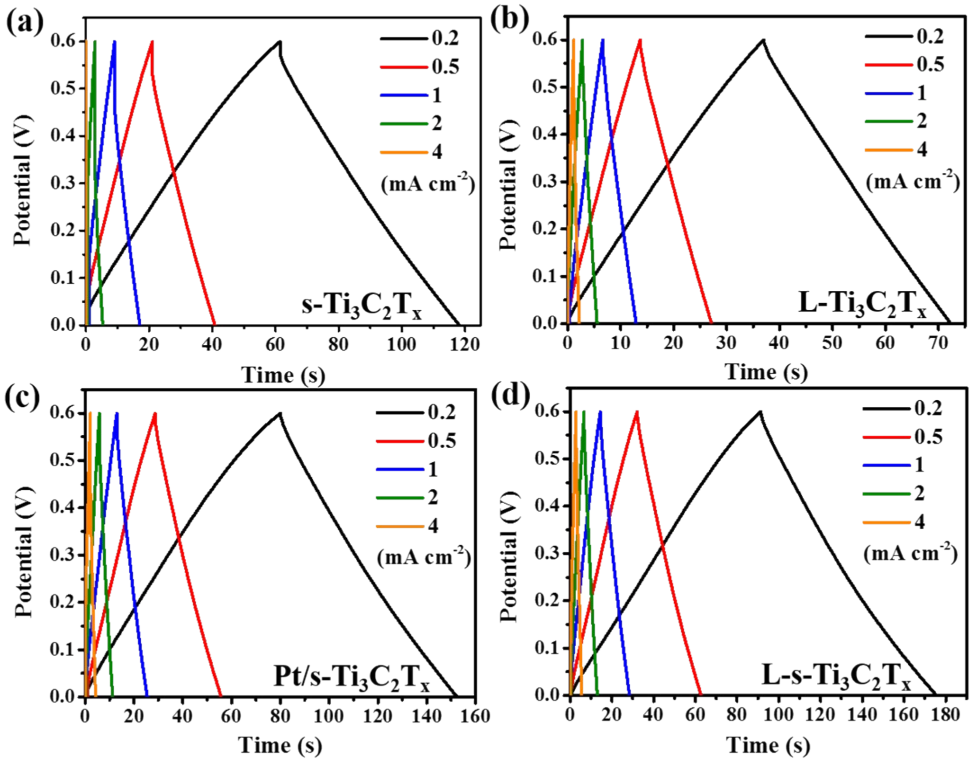

Fig. S4 Charge-discharge curves of (a) s-$Ti_3C_2T_x$, (b) L-$Ti_3C_2T_x$, (c) Pt/s-$Ti_3C_2T_x$, and (d) L-s-$Ti_3C_2T_x$ MSCs at different current densities.

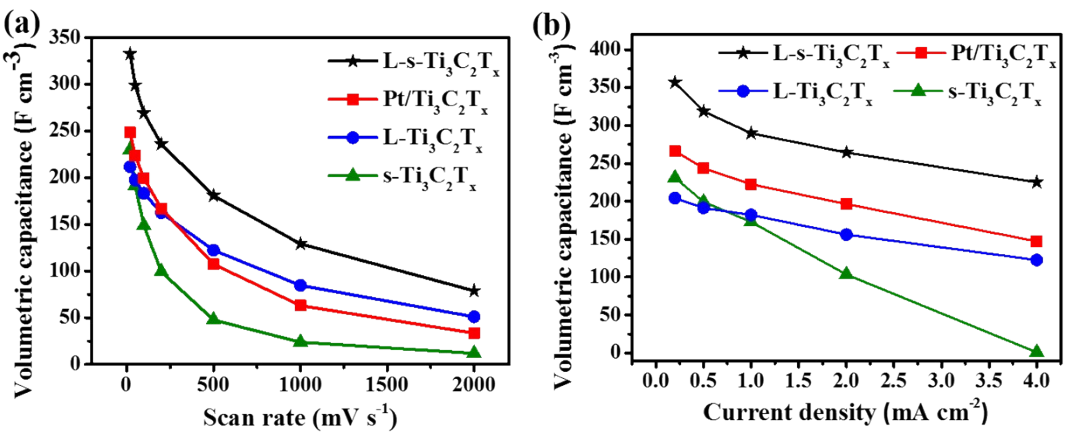

Fig. S5 Variation of volumetric capacitance with (a) scan rate and (b) current density of the MXene MSCs fabricated in this study.

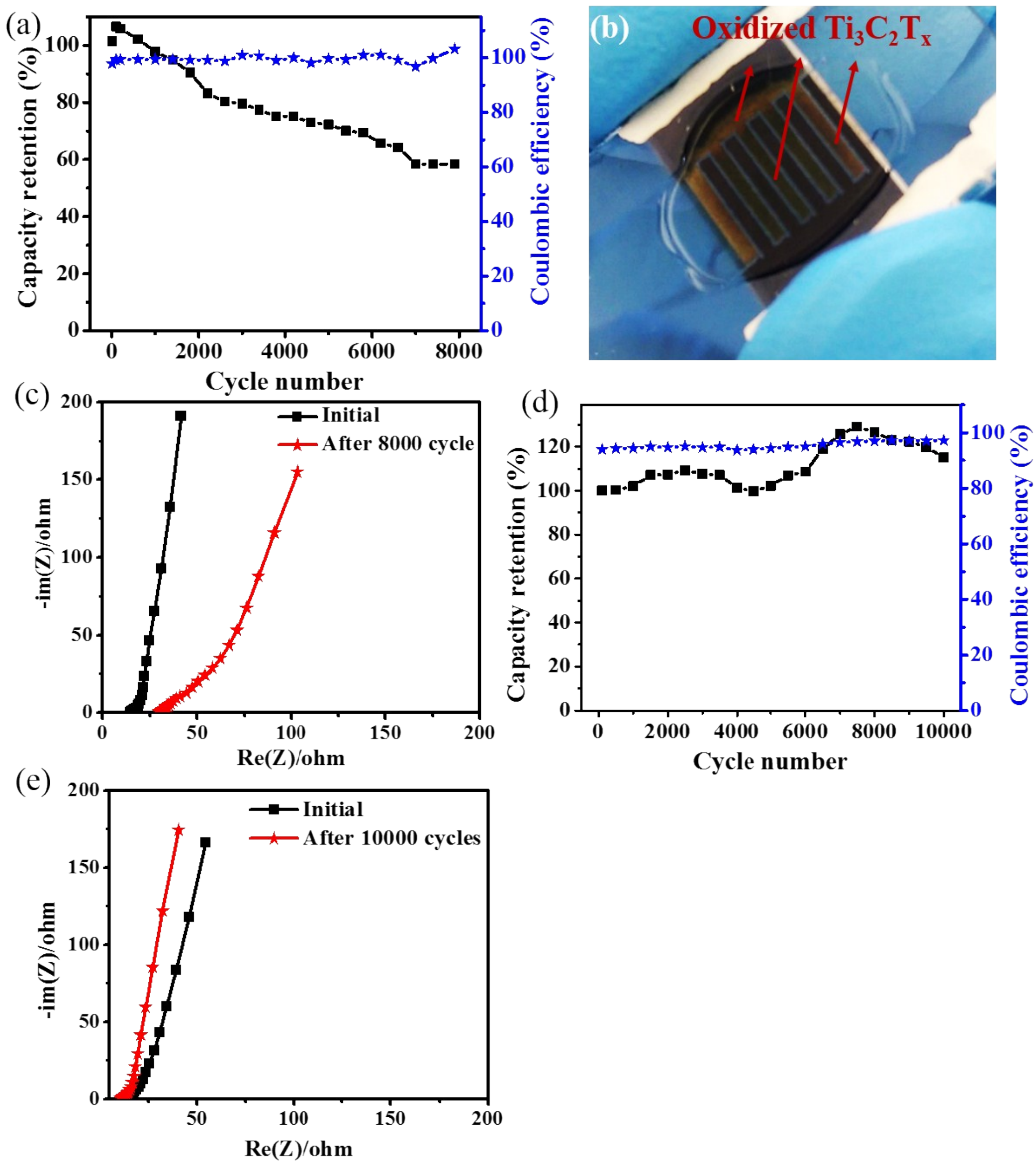

Fig. S6 (a) Cycling stability of L-s-$Ti_3C_2T_x$ MSC at a current density of 2 mA cm^{-2} for 8000 cycles. (b) Digital photograph of a L-s-$Ti_3C_2T_x$ on-chip device after 8000 cycles in a PVA/H_2SO_4 gel electrolyte. One set of MXene fingers has a lighter color (oxidized), demonstrating that the on-chip design can also be used for direct visualization of optical changes associated with electrochemical processes. (c) Changes of the Nyquist plots of L-s-$Ti_3C_2T_x$ MSC device before and after 8000 cycles. (d) Cycling stability of L-s-$Ti_3C_2T_x$ MSC for 10000 cycles after degassing process. (e) Changes of the Nyquist plots of de-gassed L-s-$Ti_3C_2T_x$ MSC device before and after 10000 cycles.

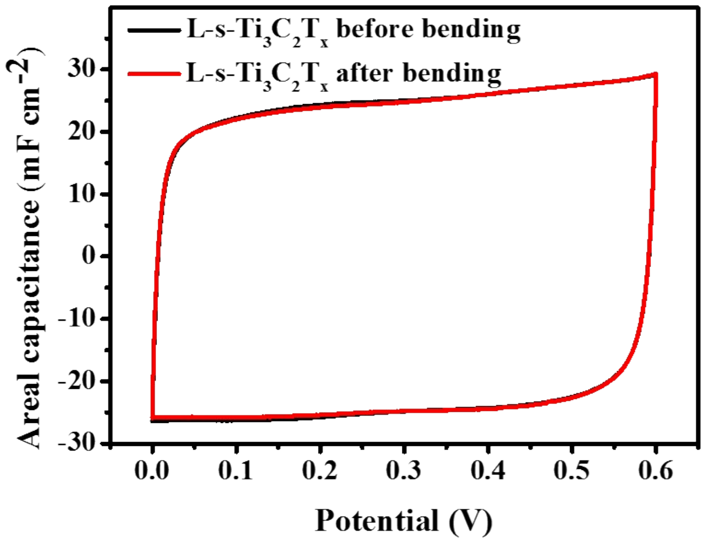

Fig. S7 CV curves of the L-s-$Ti_3C_2T_x$ MSC before and after bending for 100 times with a bending angle of 60^{o} at 5mV s^{-1}.