Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Supporting Information

Interconnected N-doped MXene Spherical Shells for Highly Efficient Capacitive Deionization

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The capacitive behaviors of electrodes can be studied in detial according to the followed equations. Generally, a power-law relationship between the peak CV current (i_p) and scan rate (v) is adopted to explain the kinetics of charge storage in the electrodes,

$$i_{\mathrm{p}} = av^{b} \qquad (1)$$

where a and b are variables, and a plot of log i versus log v should result in a straight line with a slope equal to b. The b-value provides important information on the charge storage kinetics: b=1 indicates capacitive storage, while b=0.5 is characteristic for diffusion-limited processes.

The contribution of capacitive and diffusion (intercalation pseudocapacitive) effects was calculated according to the equation

$$i(V) = k_1 v + k_2 v^{1/2} \qquad (2)$$

where i(V), k_1v, $k_2v^{1/2}$ and v are the current at a fixed potential, capacitive and diffusion-controlled currents, and scan rate, respectively. k_1 and k_2 are variable parameters, which change with the variation of the applied voltage. The contribution of capacitive (diffusion) process at a certain scan rate can be determined by calculating the value of k_1 (k_2). By plotting $v^{1/2}$ versus $i/v^{1/2}$, k_1 can be determined from the slope of a straight line. At a specific voltage, k_1v is the contribution of the pseudocapacitance to the $i(V)$. A series of k_1v can be calculated under different voltages, which can be utilized to draw the curves of pseudocapacitance. By comparing the integral areas, the contribution of capacitive and diffusion (intercalation pseudocapacitive) can be calculated.

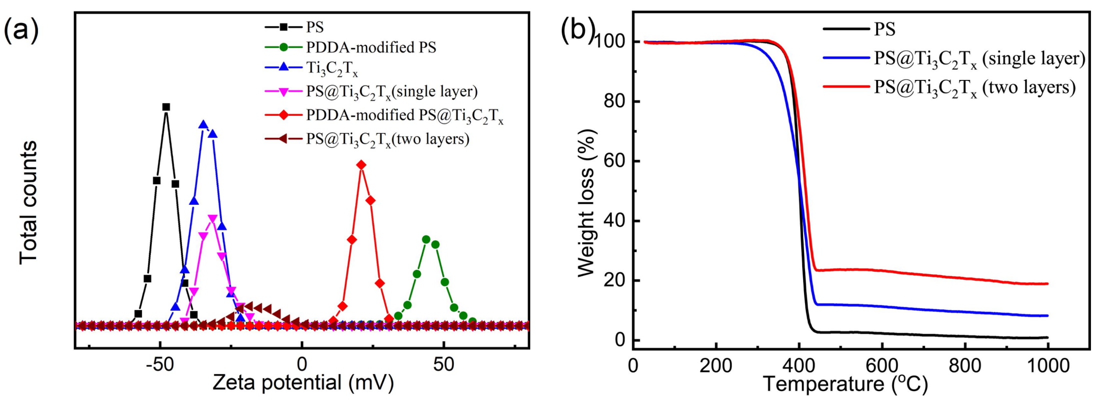

Figure S1. (a) Zeta-potential values of samples. (b) The contents of $Ti_3C_2T_x$ in core-shell composites.

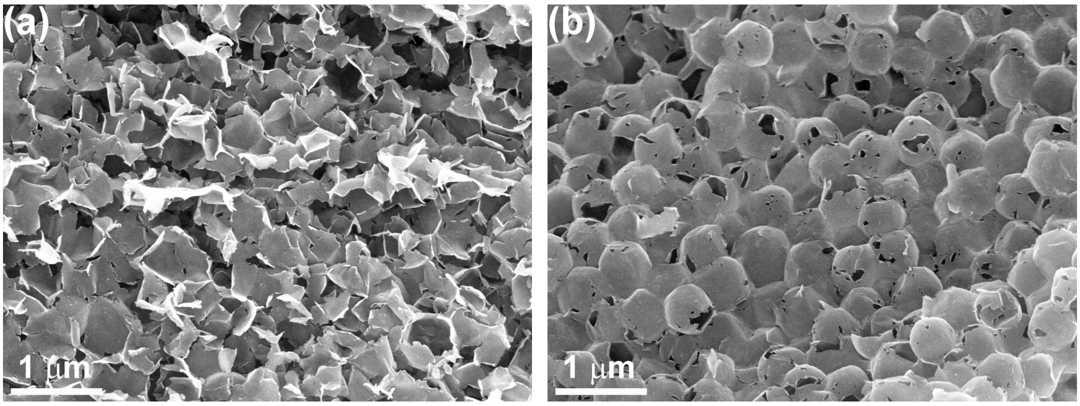

Fig. S2. FESEM images of N-doped samples with (a) single layer and (b) three layer of $Ti_3C_2T_x$

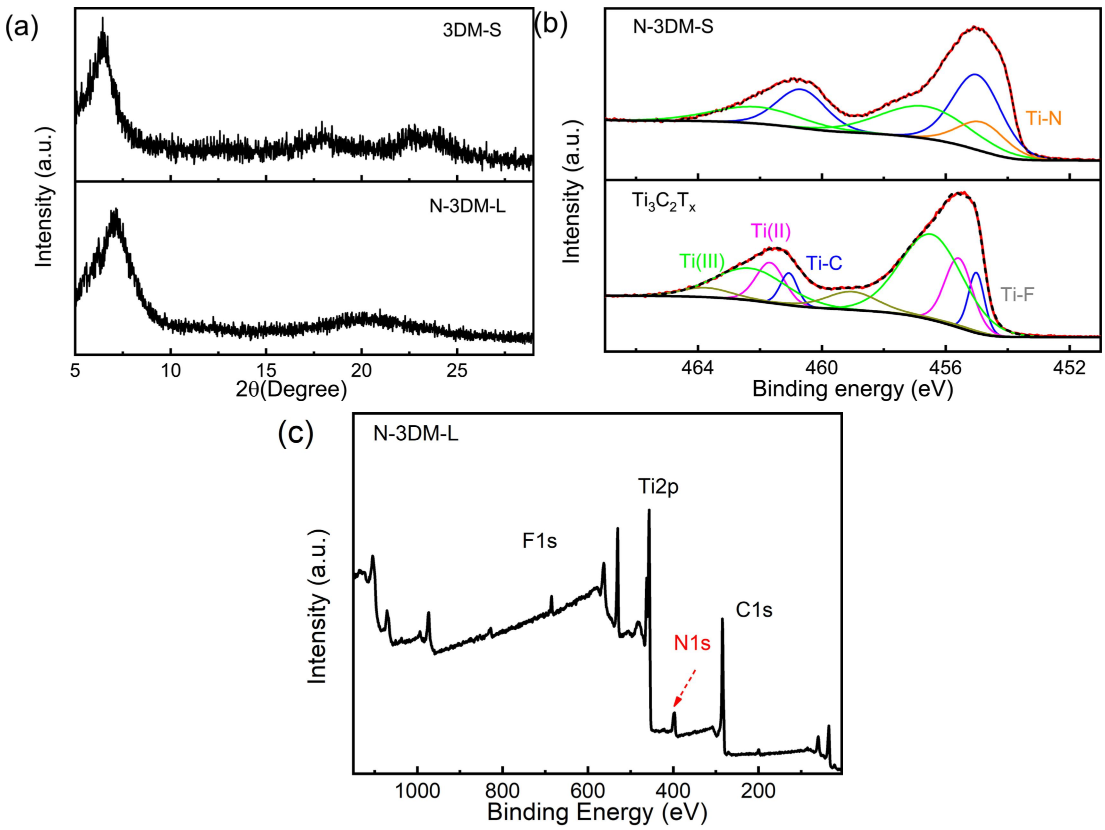

Fig. S3. (a) XRD patterns of 3DM-S and N-3DM-L samples, (b) Deconvolution of high resolution XPS spectra for Ti, and (c) the XPS spectrum of control N-3DM-L sample

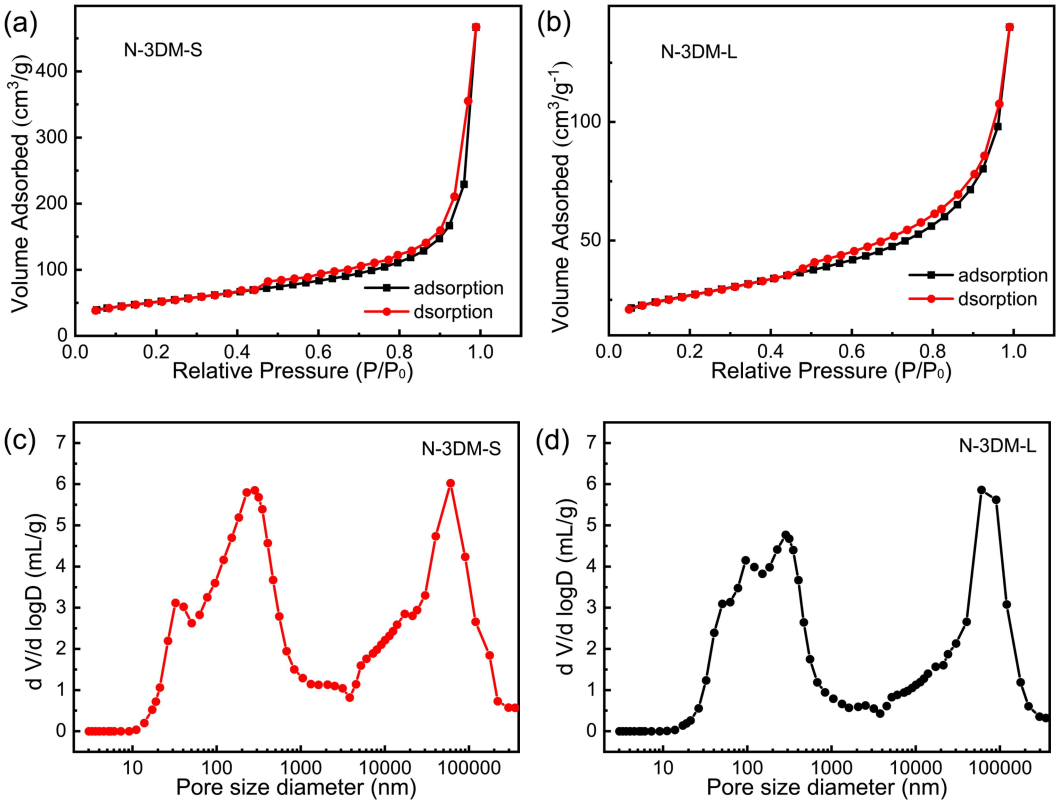

Fig. S4. Nitrogen adsorption-desorption isotherms of (a) N-3DM-S and (b) N-3DM-L. Mercury penetration curves of (c) N-3DM-S and (d) N-3DM-L.

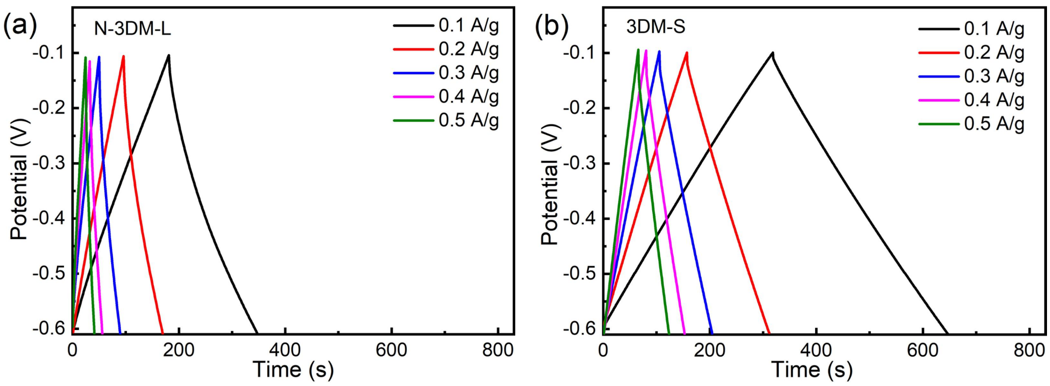

Fig. S5. Galvanic charging curves of (a) N-3DM-L and (b) 3DM-S electrodes

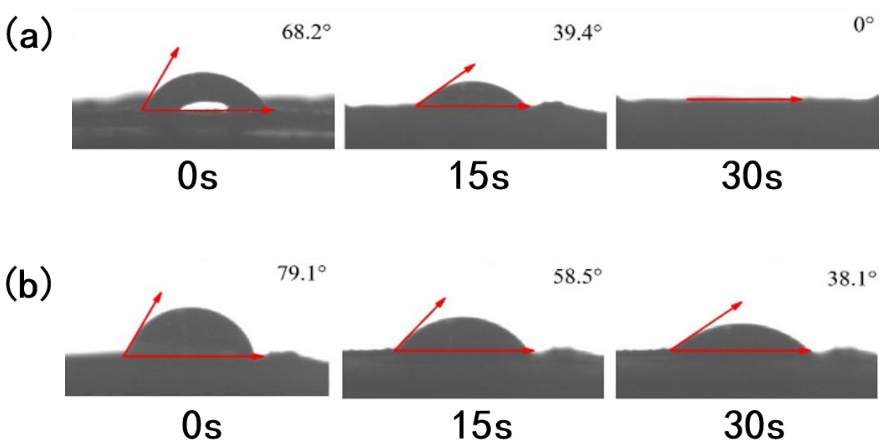

Fig. S6. Contact angle tests of (a) N-3DM-S and (b) 3DM-S.