Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting information

MXene-supported stable adsorbents for superior CO_2 capture

Fa-Qian Liu, Xin Liu, Lishui Sun, Rongxun Li, Chun-Xiao Yin, and Bozhen Wu

Calculation of amine distribution state.

The amine distribution state was measured using ^{13}C NMR. the quantitative amine distribution was calculated by the equation: [1]

For Ti_3C_2/PEI,

$$primary{:}secondary{:}tertiary = (A_a + A_b){:}\frac{(A_c + A_d + A_e)}{2}{:}\frac{(A_f + A_g + A_h)}{3} \quad (4)$$

For Ti_3C_2/PEI/BO,

$$primary{:}secondary{:}tertiary = (A_a + A_b){:}\frac{(A_c + A_d + A_e + A_1)}{2}{:}\frac{(A_f + A_g + A_h + A_{1'})}{3} \quad (5)$$

where, Ai is the integrated peak area for i carbon species.

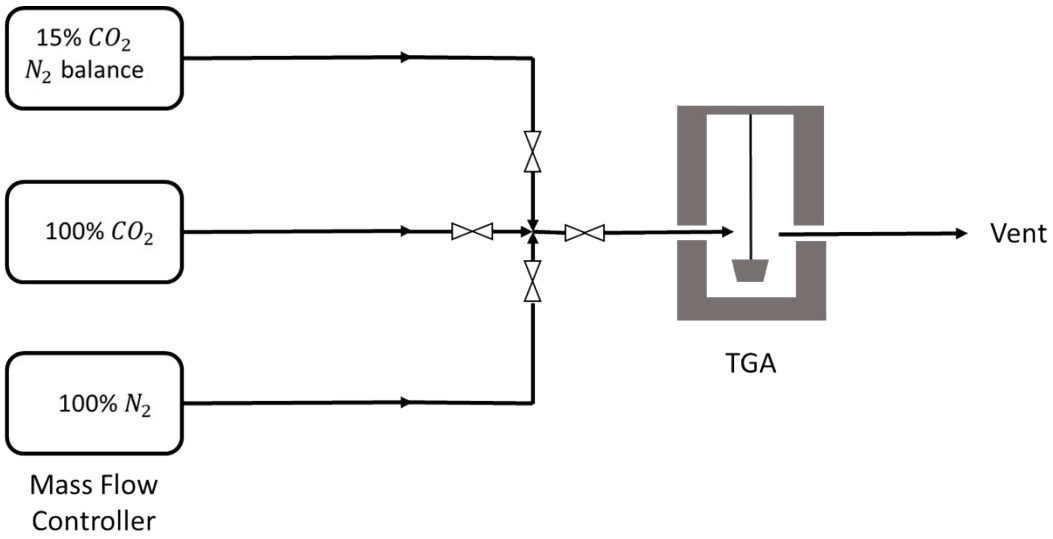

Fig. S1 A schematic diagram of TGA test system.

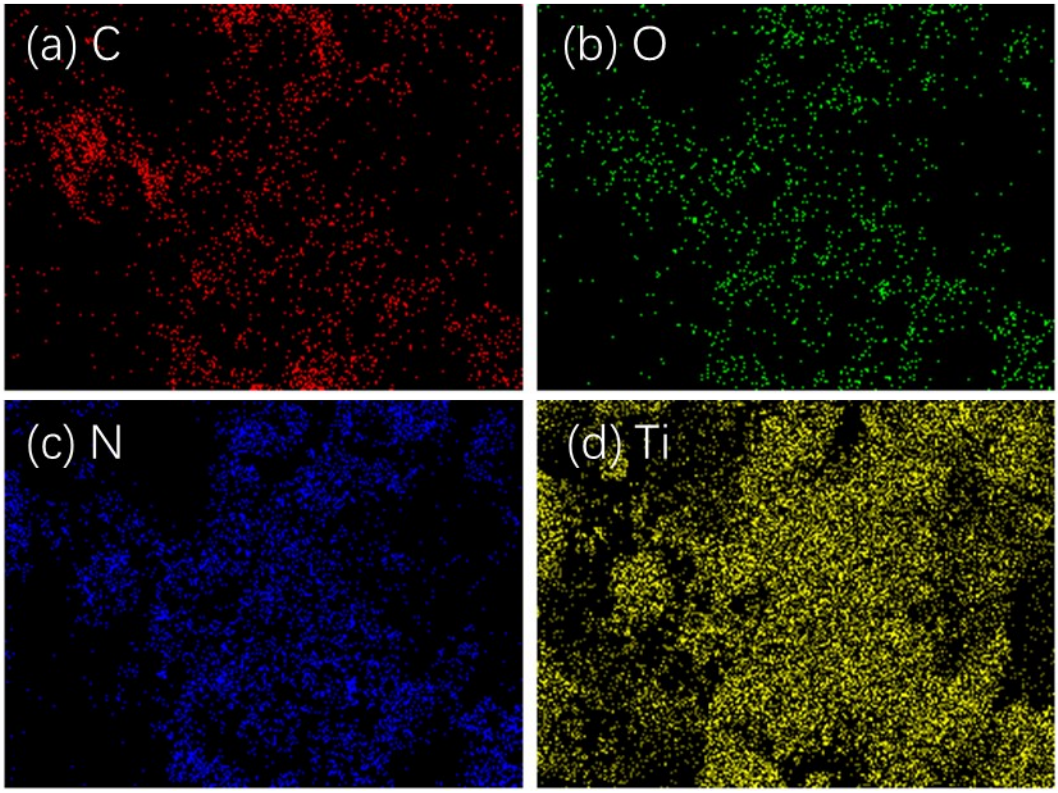

Fig. S2. Energy dispersive spectroscopy (EDS) mapping of Ti_3C_2/PEI/BO nanocomposite: (a) carbon element mapping, (b) oxygen element mapping, (c) nitrogen element mapping and (d) Titanium element mapping.

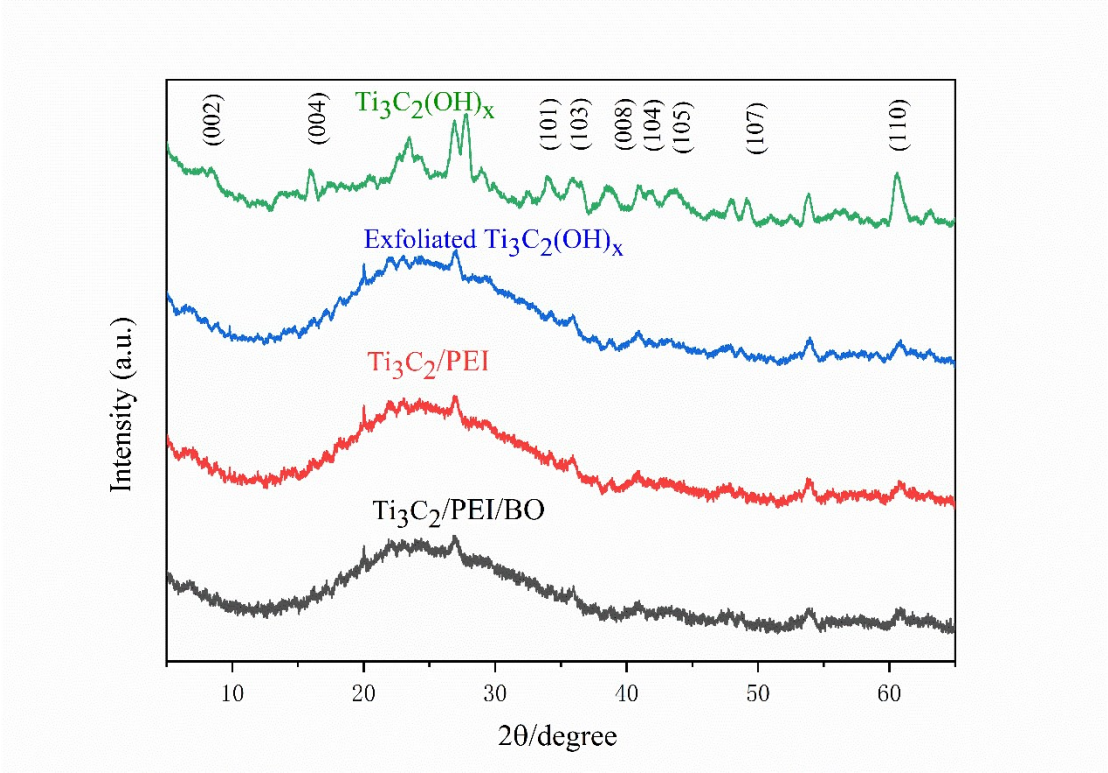

Fig. S3. XRD patterns of $Ti_3C_2(OH)_x$ before and after the polymerization of PEI and BO.

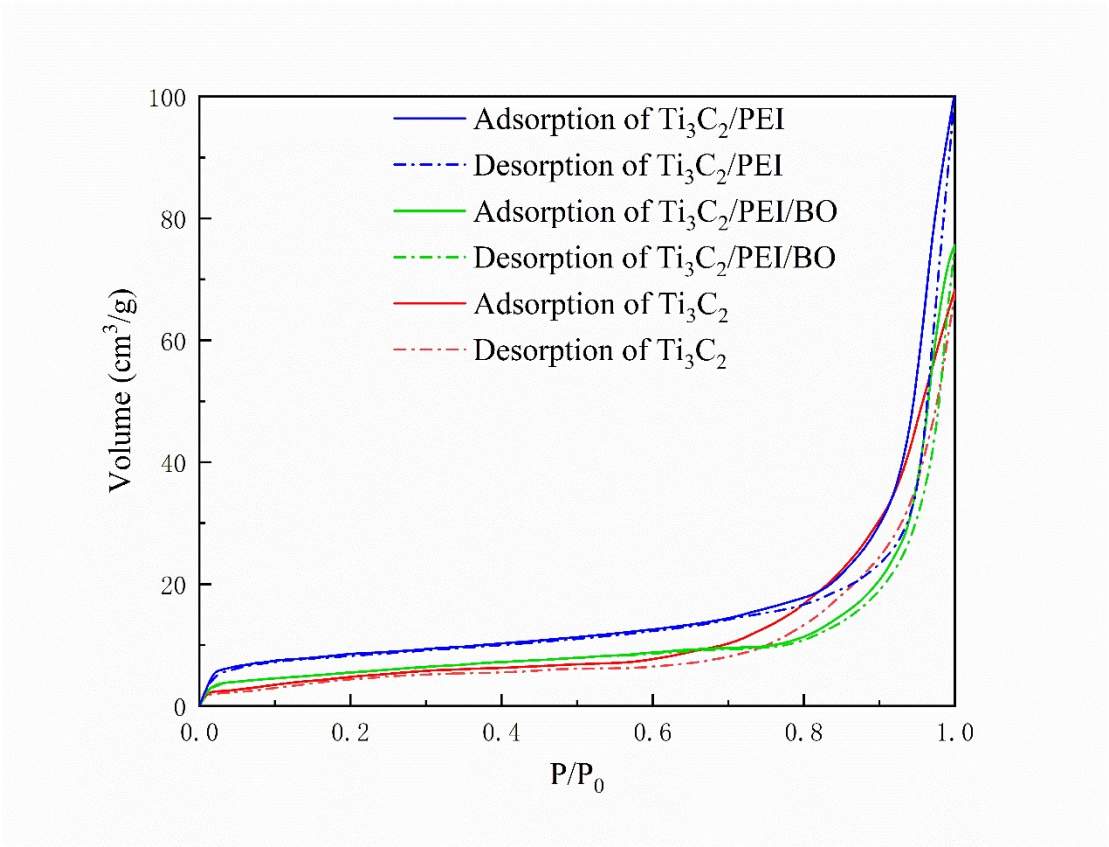

Fig. S4 Nitrogen adsorption/desorption isotherms of Mxene and Mxene-supported amine adsorbents.

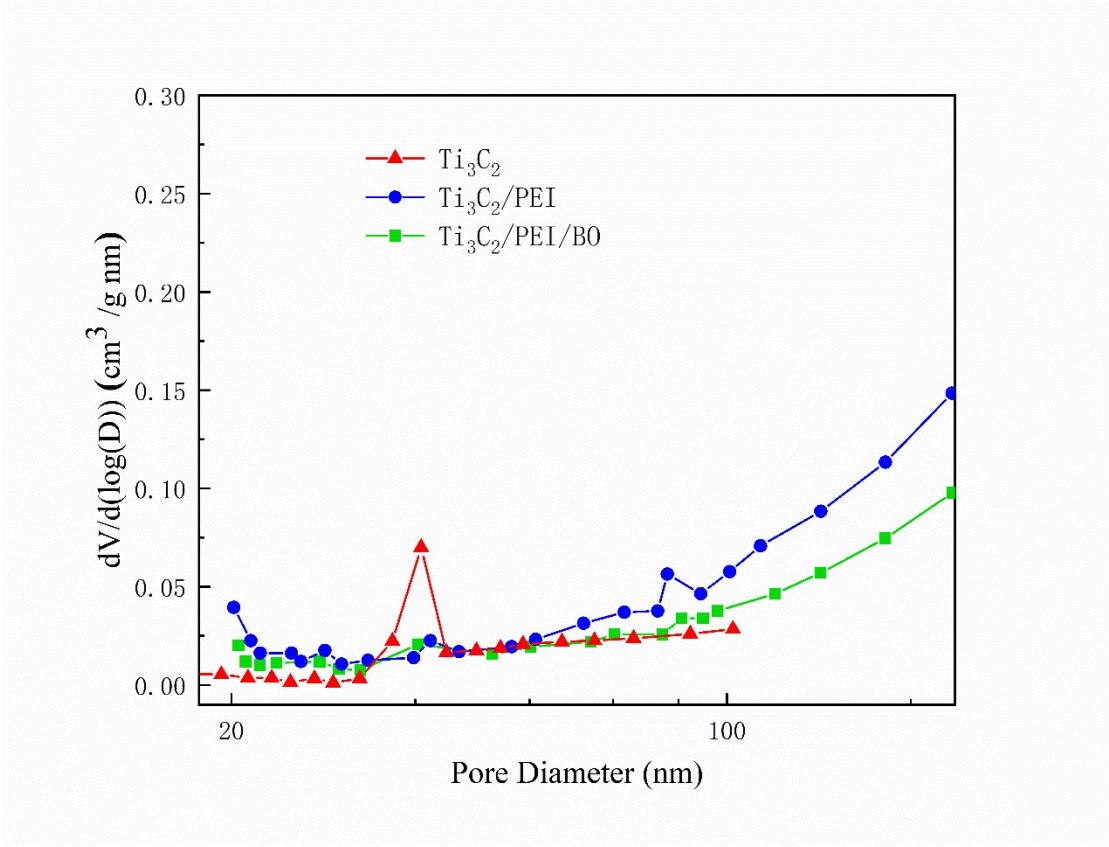

Fig. S5 pore size distribution calculated from the desorption branch.

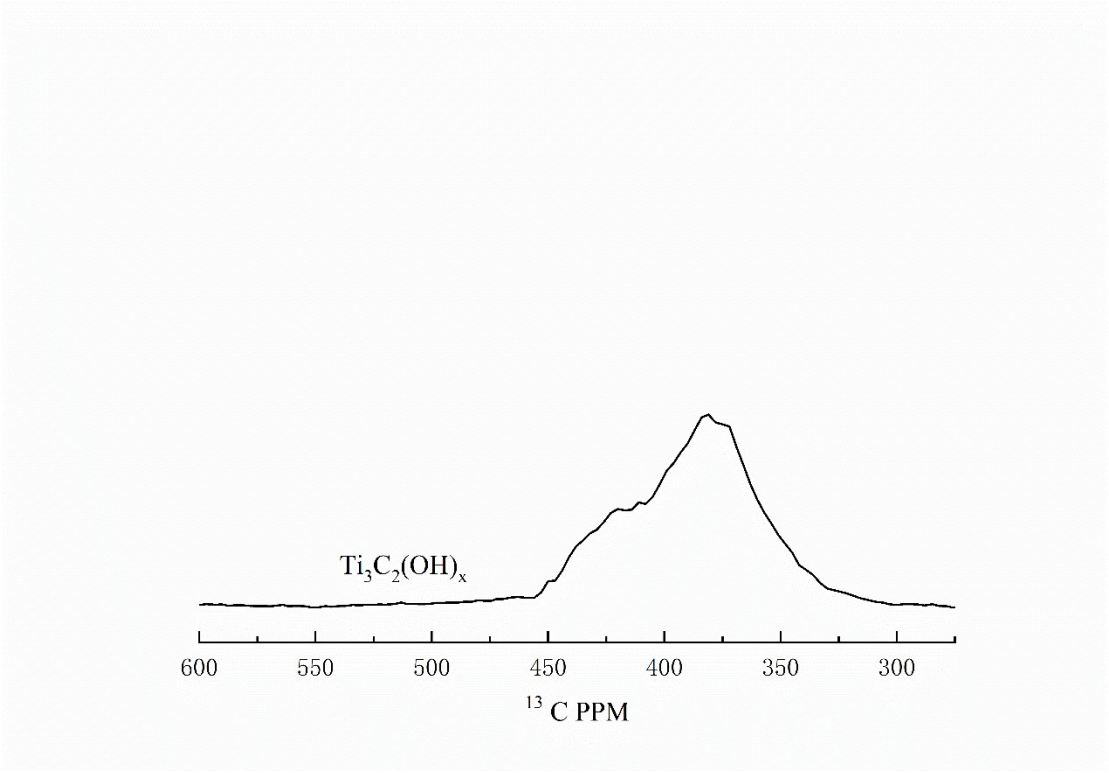

Fig. S6. ^{13}C-NMR spectrum of the chemical shifts for $Ti_3C_2(OH)_x$.

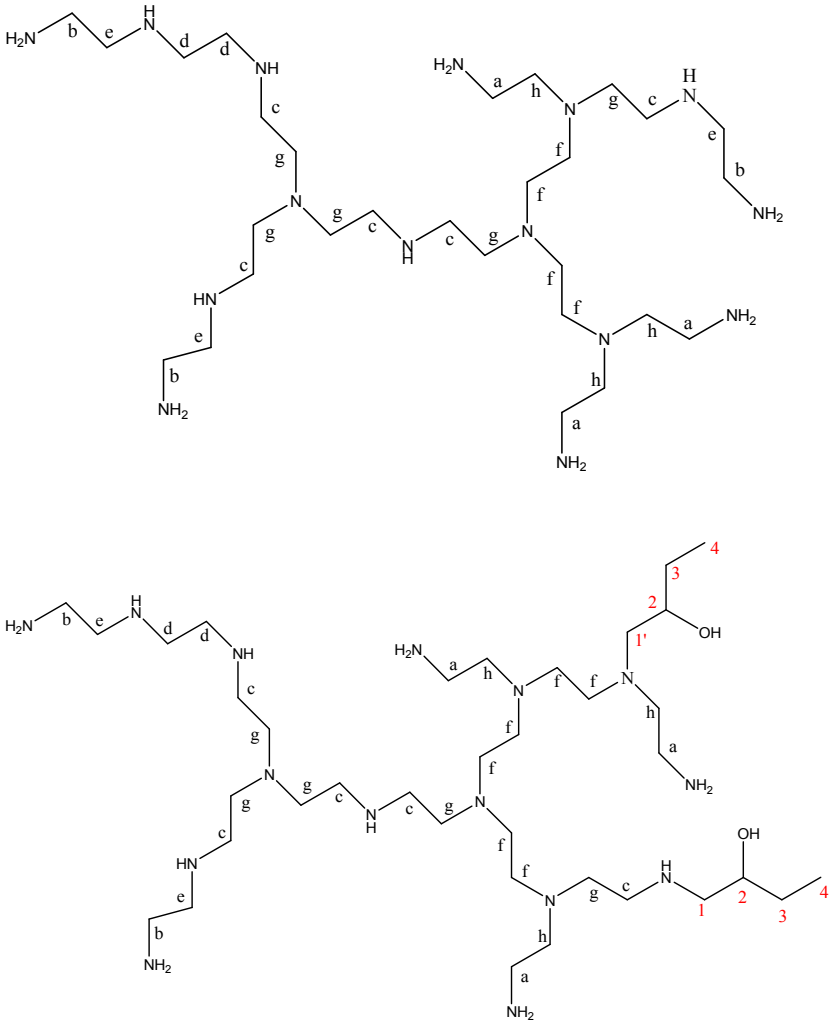

Fig. S7. Molecular structure of PEI and BO functioned PEI

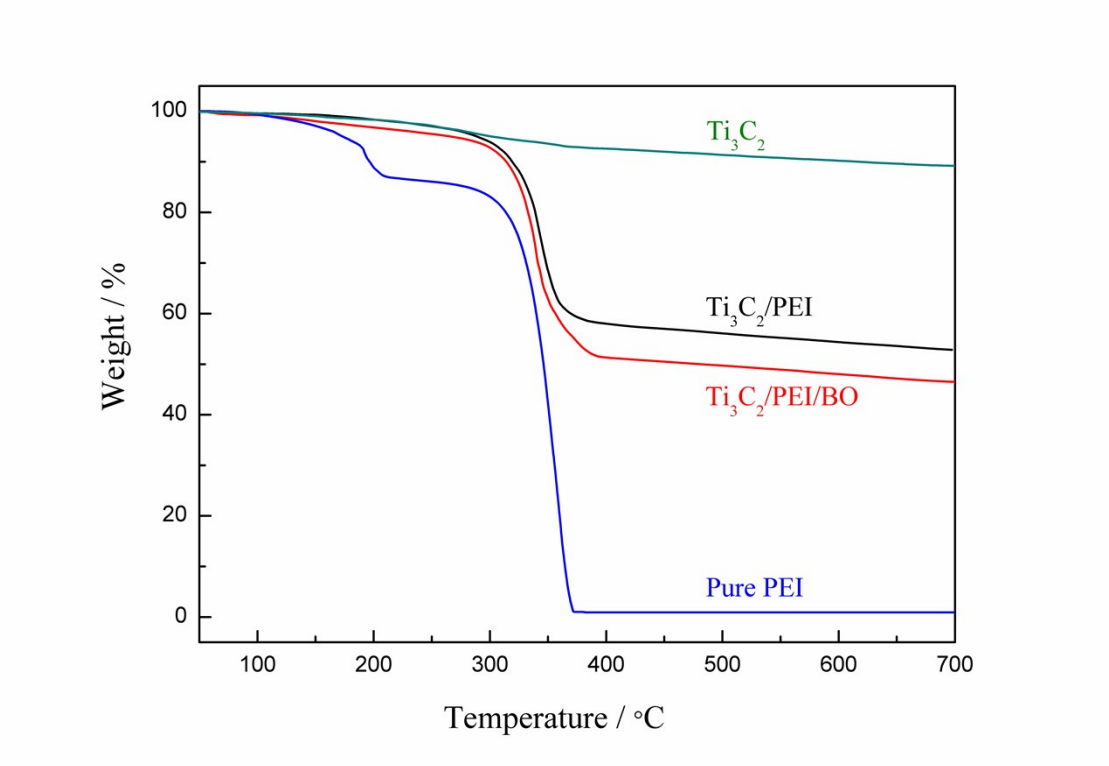

Fig. S8 TGA thermograms of Ti_3C_2, Ti_3C_2/PEI, Ti_3C_2/PEI/BO, and commercial PEI with molecular weights of 1800.

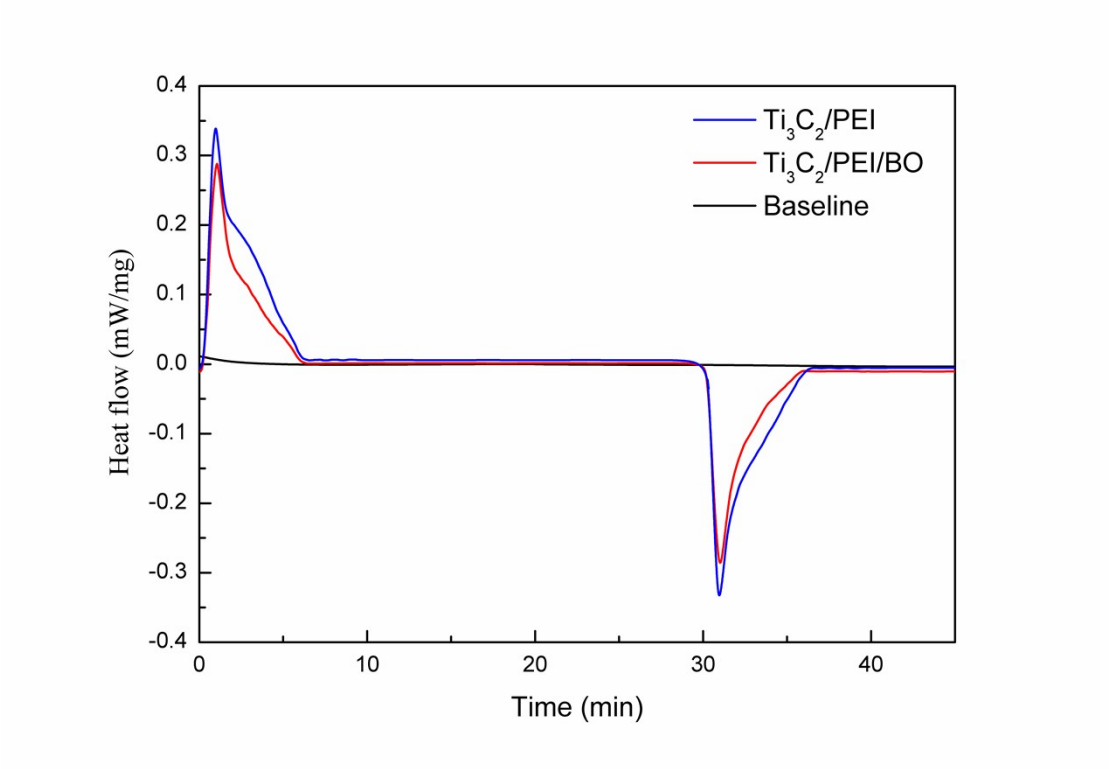

Fig. S9. The DSC heat flow profiles of Ti_3C_2/PEI and Ti_3C_2/PEI/BO during adsorption and desorption processes.

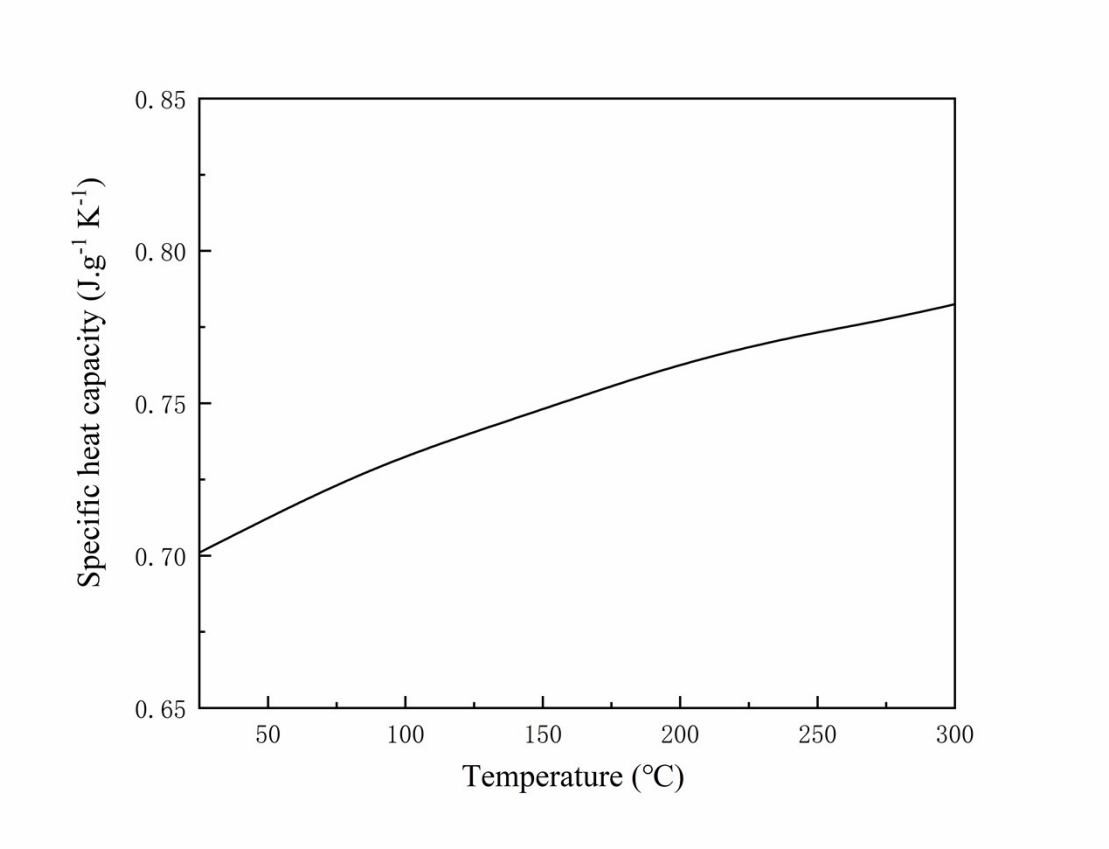

Fig. S10 Specific heat capacity experimental result of $Ti_3C_2(OH)_x$.

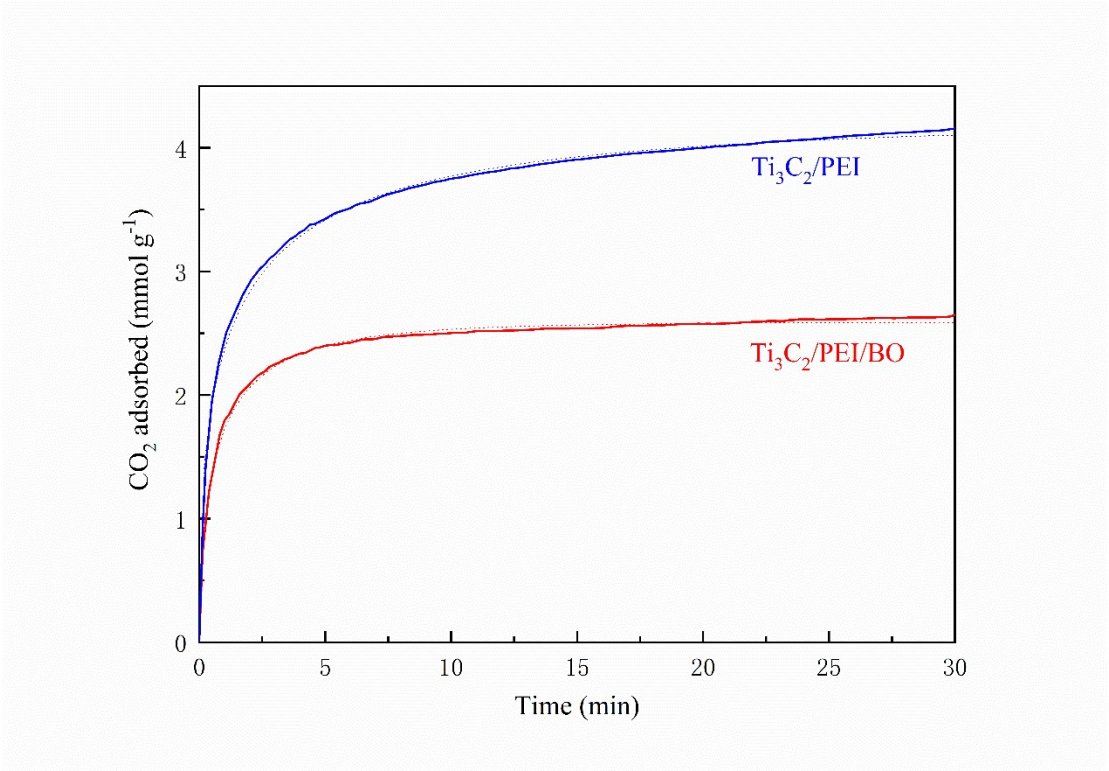

Fig. S11 CO_2 adsorption profiles of MXene-based adsorbents. CO_2 adsorption was measured in a simulated flue gas containing 15 % CO_2 and 85 % N_2 at 25℃. The solid lines indicate the CO_2 uptake profiles of the adsorbents measured experimentally, and the dotted lines indicate the fitting curves obtained from the Avrami kinetic equation.

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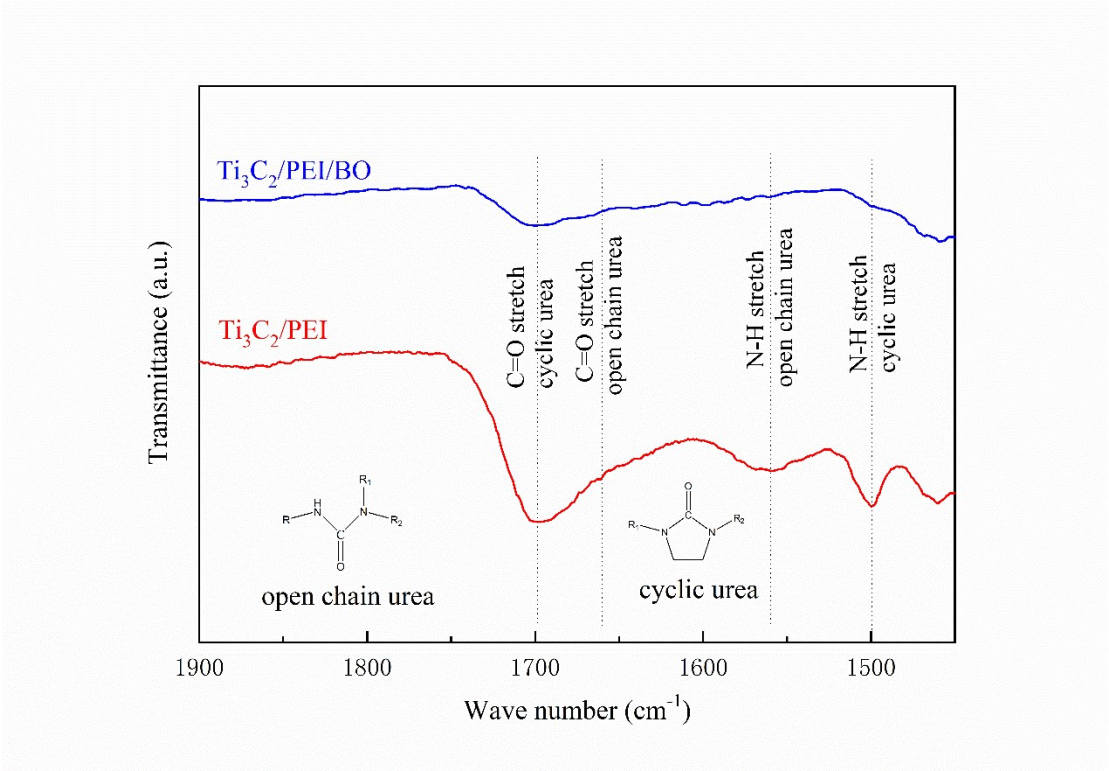

Fig. S12 FT-IR spectra of MXene-based adsorbents measured after 50 consecutive adsorption-desorption cycles (adsorption: 15% CO_2 balanced with N_2 at 25℃; desorption: 100% CO_2 at 120 ℃).

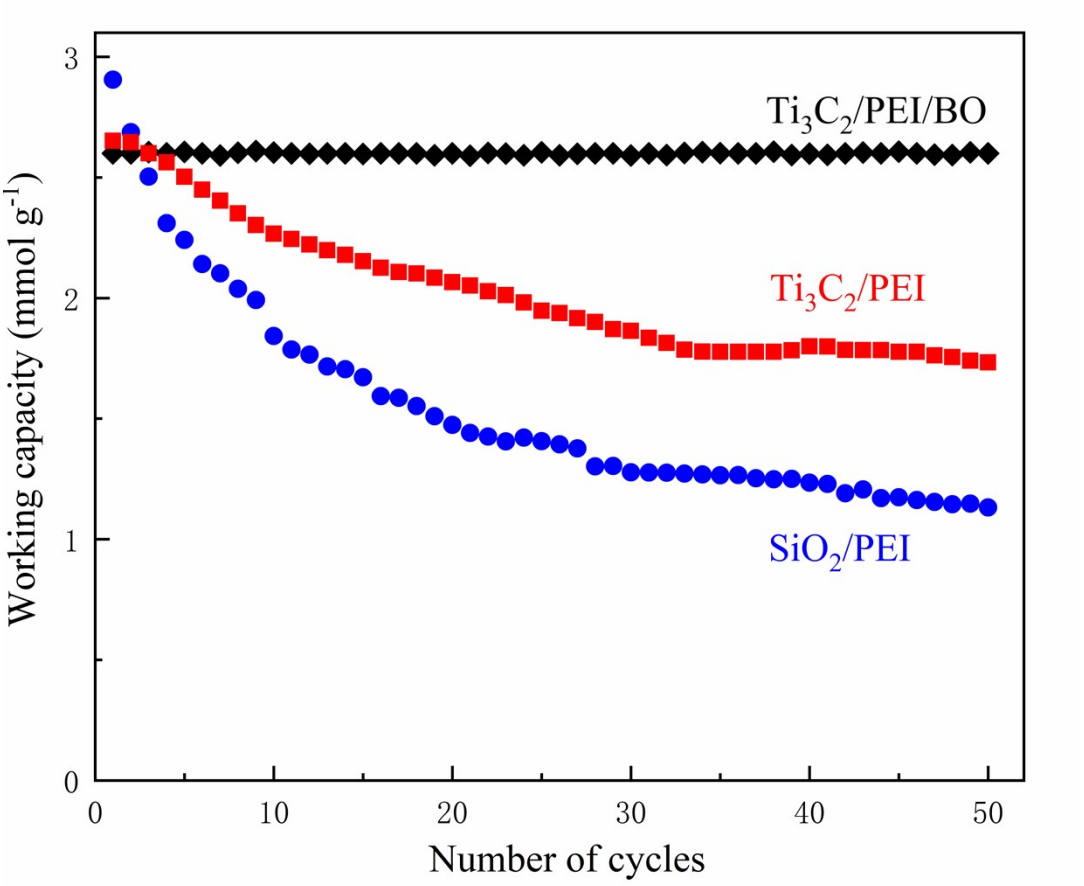

Fig. S13 Long-term cyclic stability of MXene-based adsorbents and SiO_2 based adsorbents [1].

(1) Choi, W.; Min, K.; Kim, C.; Ko, Y. S.; Jeon, J. W.; Seo, H.; Park, Y.-K.; Choi, M. Epoxide-functionalization of polyethyleneimine for synthesis of stable carbon dioxide adsorbent in temperature swing adsorption. *Nat. Commun.* **2016,** *7*, 12640.