$Ti_3C_2T_x$ MXene and Mn_3O_4 nanoparticles synergistically promote the electrochemical synthesis of ammonia under ambient conditions

Supporting information

Argon and nitrogen were separately introduced into the electrolyte for 2 hours, and subsequent testing was conducted.

Nitrite Nitrogen Detection Procedure:

Take 10 mL of the electrolyte, add 1 mL of sulfanilic acid solution, wait for 10 minutes, then add 1 mL of sodium acetate solution and 1 mL of α-naphthylamine solution. Keep the mixture in the dark, and measure using a UV-Vis spectrophotometer at a wavelength range of 400–700 nm.

Nitrate Nitrogen Detection Procedure:

Take 5 mL of the electrolyte, add 1 mL of 1 mol/L hydrochloric acid (HCl) solution, and keep it in the dark. Measure the absorbance using a spectrophotometer at a wavelength of 220 nm.

The data in table1 revealed that the absorbance intensities of the three ions were identical in the blank electrolyte as well as after argon or nitrogen treatment. This confirms that neither the argon nor the nitrogen contained any other nitrogen species.

Table S1 The absorbance of different electrolytes

	Absorbance											
Ions	Blank 1	Blank 2	Blank 3	Blank average	Ar 1	Ar 2	Ar 3	Ar average	N_2 1	N_2 2	N_2 3	N_2 average
NH_4^+	0.038	0.032	0.035	0.035	0.032	0.041	0.038	0.037	0.029	0.03	0.027	0.028
NO_2^-	0.03	0.039	0.031	0.033	0.037	0.033	0.04	0.036	0.035	0.033	0.033	0.033
NO_2^-	0.048	0.044	0.047	0.046	0.058	0.051	0.047	0.052	0.048	0.059	0.054	0.053

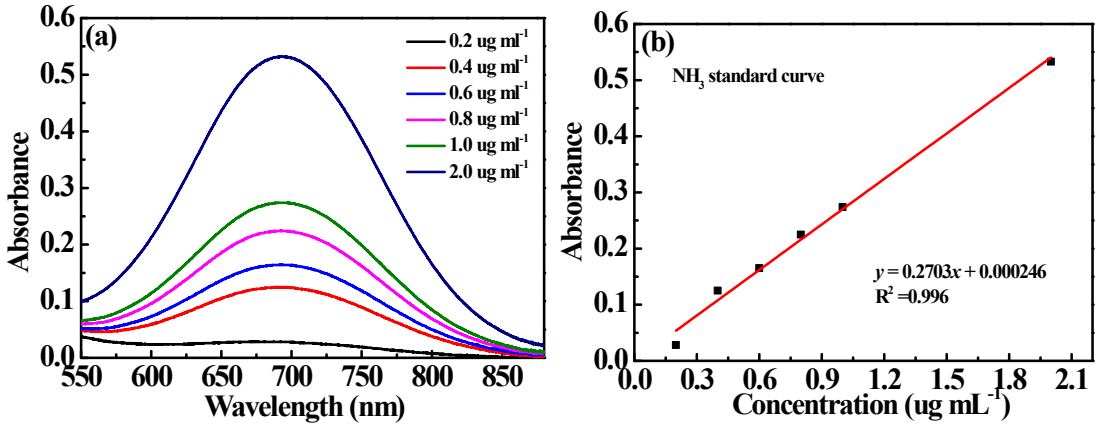

Fig. S1 (a) UV−Vis absorption spectra of various NH_4^+ concentrations after incubated for 2h at room temperature. (b) Calibration curve used for calculating NH_4^+ concentrations.

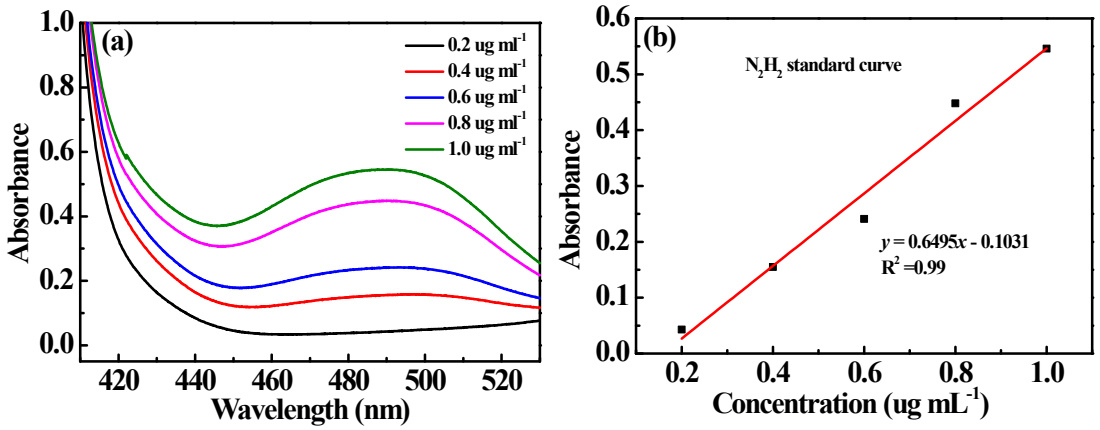

Fig. S2 (a) UV−Vis absorption spectra of various N_2H_4 concentrations after incubated for 20 min at room temperature. (b) Calibration curve used for calculation of N_2H_4 concentrations.

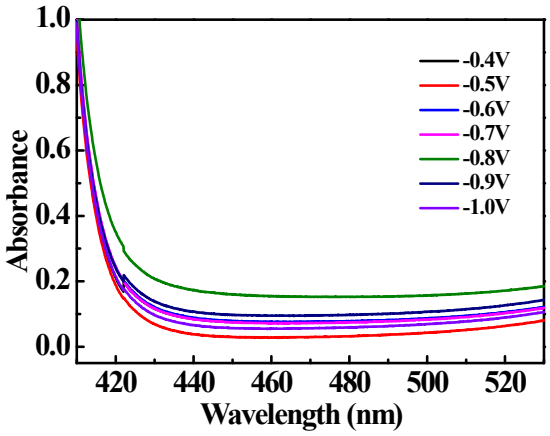

Fig. S3 UV-vis absorption spectra of electrolytes stained with the Watt and Crisp methods.

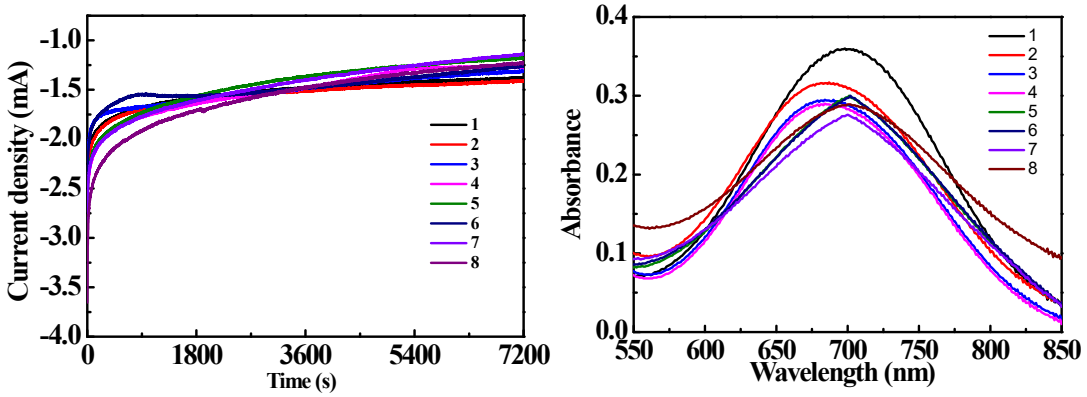

Fig. S4 UV-vis absorption spectra of electrolytes with alternating 2h of cycles in N_2-saturated electrolytes, stained with indophenol indicator for 2 h

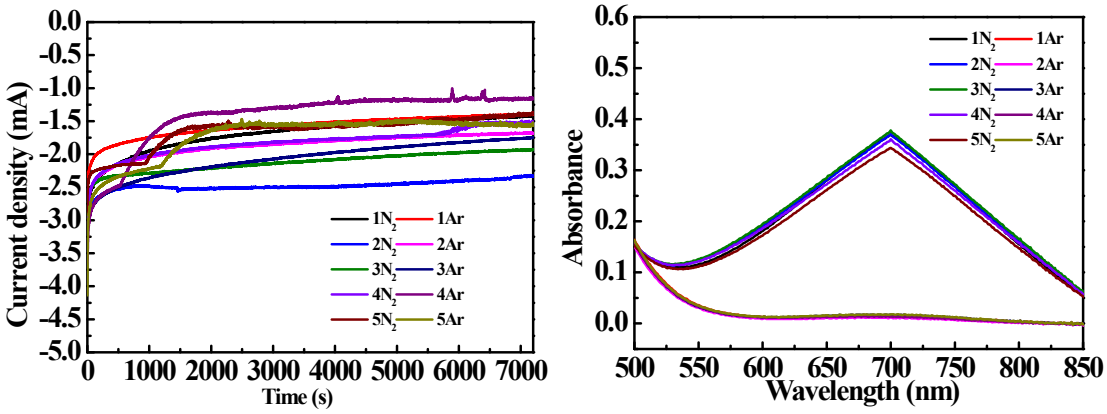

Fig. S5 UV-vis absorption spectra of electrolytes with alternating 2h of cycles in N_2- and Ar-saturated electrolytes, stained with indophenol indicator for 2 h

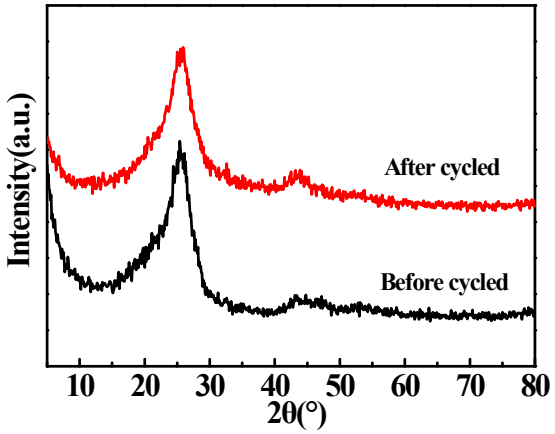

Fig. S6 XRD patterns of the electrode before and after cycling at -0.6V for 22h.

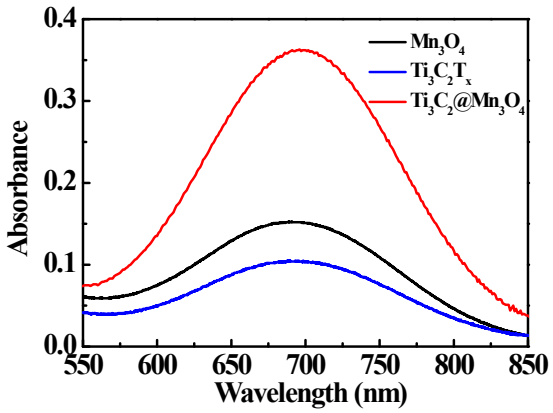

Fig. S7 UV-vis absorption spectra of electrolytes catalyzied by Mn_3O_4, $Ti_3C_2T_x$ and $Ti_3C_2@Mn_3O_4$ in N_2-saturated electrolytes, stained with indophenol indicator for 2 h