Supporting Information for

Porous and Ultra-Flexible Crosslinked MXene/Polyimide Composites for Multifunctional Electromagnetic Interference Shielding

Zhi-Hui Zeng[1, #, *], Na Wu[2, #], Jing-Jiang Wei[3], Yun-Fei Yang[1], Ting-Ting Wu[4], Bin Li[1], Stefanie Beatrice Hauser[4], Wei-Dong Yang[5], Jiu-Rong Liu[1, *], Shan-Yu Zhao[4, *]

[1]School of Materials Science and Engineering, Shandong University, Jinan 250061, P. R. China

[2]Department of Chemistry and Applied Biosciences, ETH Zurich, CH-8093 Zurich, Switzerland

[3]Laboratory for Cellulose and Wood Materials, Swiss Federal Laboratories for Materials Science and Technology (Empa), 8600 Dübendorf, Switzerland

[4]Laboratory for Building Energy Materials and Components, Swiss Federal Laboratories for Materials Science and Technology (Empa), 8600 Dübendorf, Switzerland

[5]School of Aerospace Engineering and Applied Mechanics, Tongji University, Shanghai 200092, P. R. China

[#]Zhi-Hui Zeng and Na Wu contributed equally to this work

*Corresponding authors. E-mail: zhihui.zeng@sdu.edu.cn (Z.-H Zeng), jrliu@sdu.edu.cn (J.-R Liu), shanyu.zhao@empa.ch (S.-Y Zhao)

Supplementary Figures and Tables

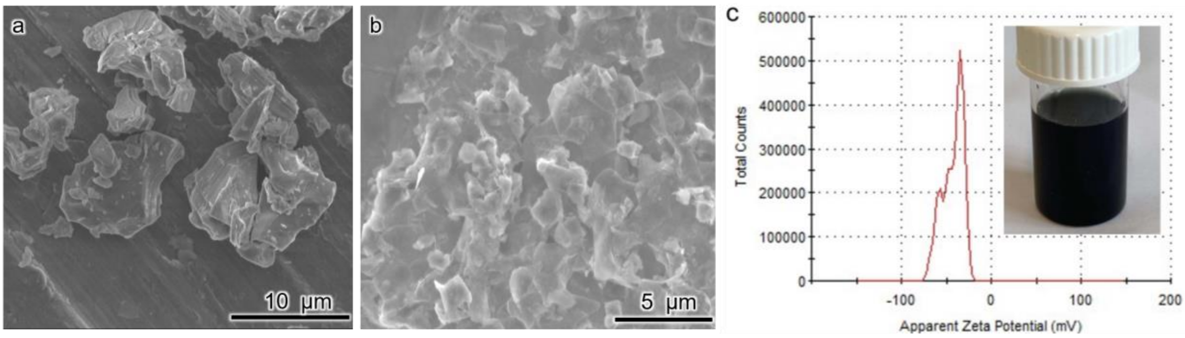

Fig. S1 SEM images of the (**a**) MAX precursor and (**b**) m-$Ti_3C_2T_x$. More details can be seen from our previous work [S26]. (**c**) Zeta potential of as-prepared MXene and photograph of the MXene aqueous dispersion, showing the stability of the dispersion

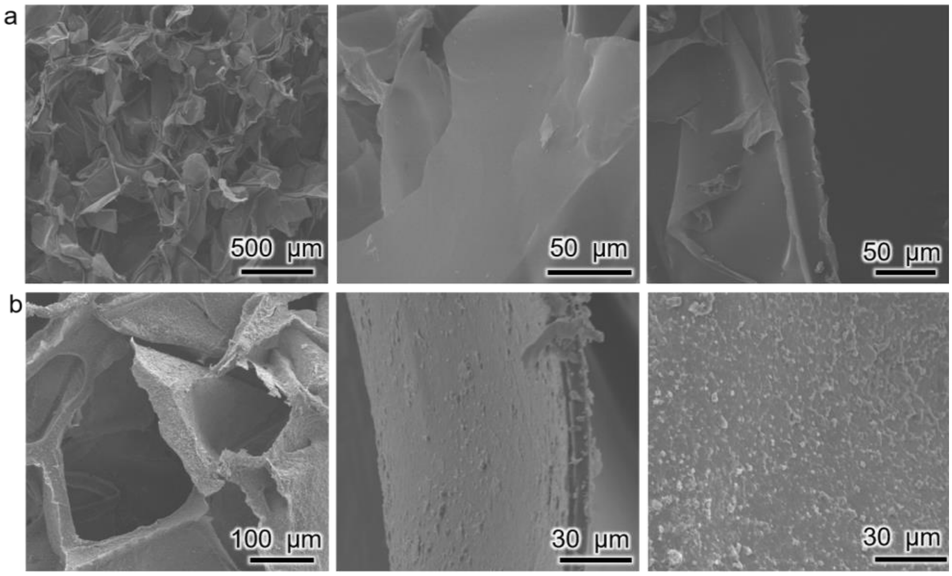

Fig. S2 SEM images of (**a**) pure PI foams and (**b**) C-MXene@PI composite (coated 14 times with MXene) foams

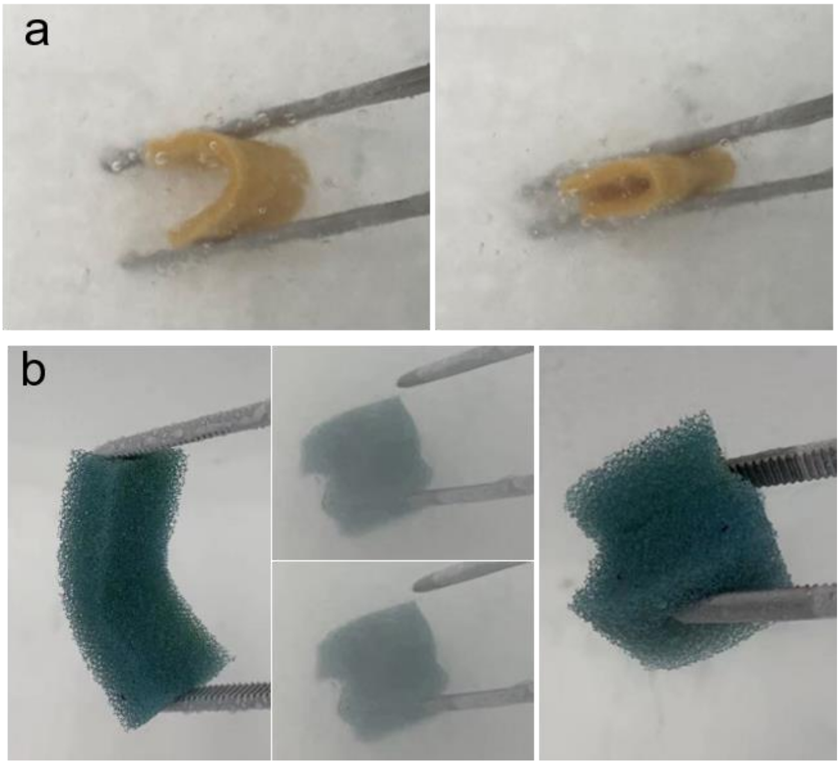

Fig. S3 Photographs of the (**a**) as-prepared pure PI foams and (**b**) commercial PU foams soaked in the liquid nitrogen, showing the robustness and flexibility of the PI foams while the PU foams broke easily after bent in liquid nitrogen

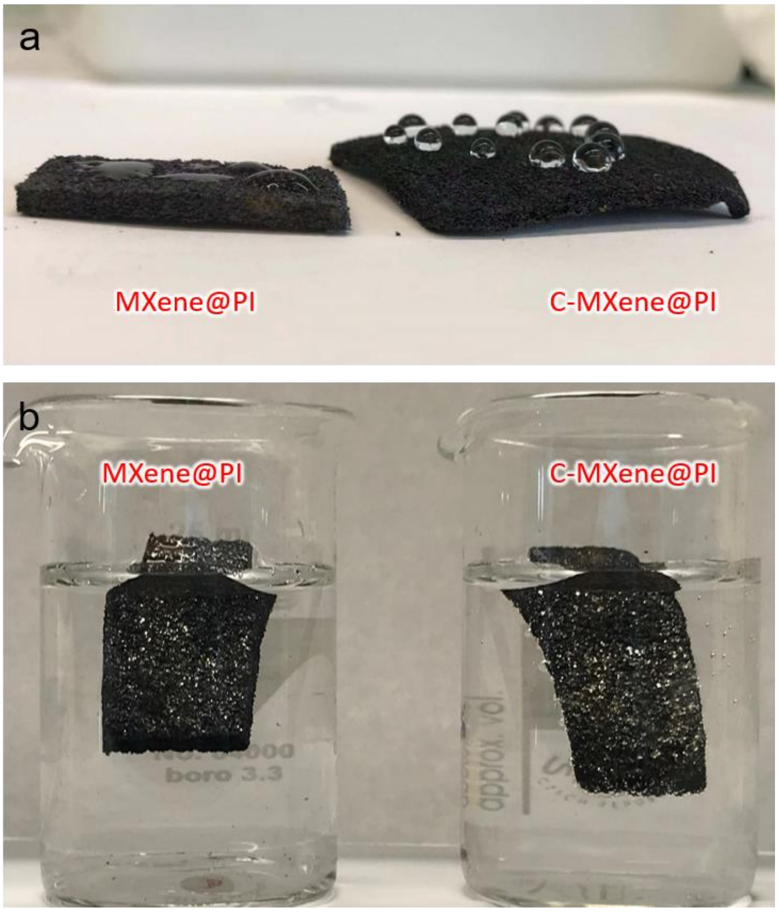

Fig. S4 (**a**) Photographs of the MXene@PI and C-MXene@PI composite foams showing the surface wettability with water. (**b**) Photographs of the MXene@PI and C-MXene@PI composite foams when immersed in water without further treatment

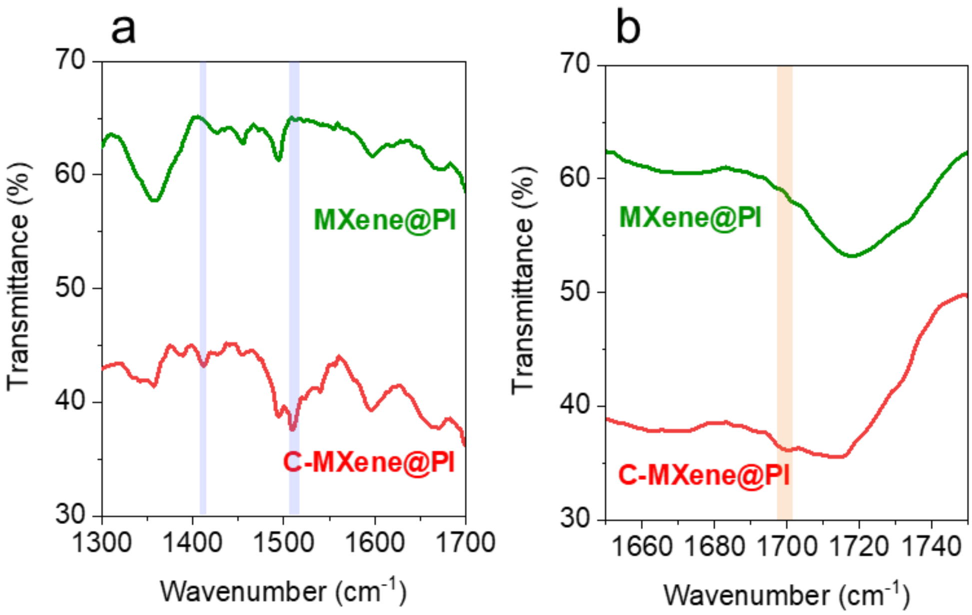

Fig. S5 (**a**) Emblematic benzene bands on PMDI. (**b**) The carbonyl stretching region of an urethane mode

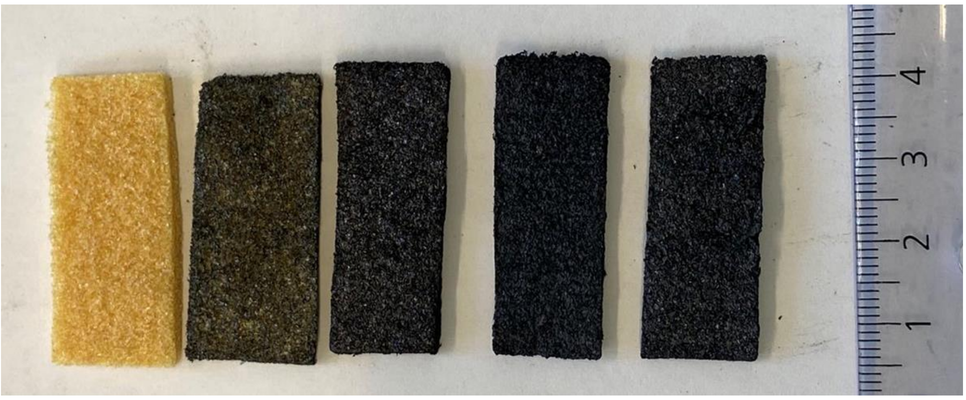

Fig. S6 Photograph of the C-MXene@PI composite foams with various coating times/layers (2L, 4L, 10L, 16L C-MXene@PI foams are shown from left to right)

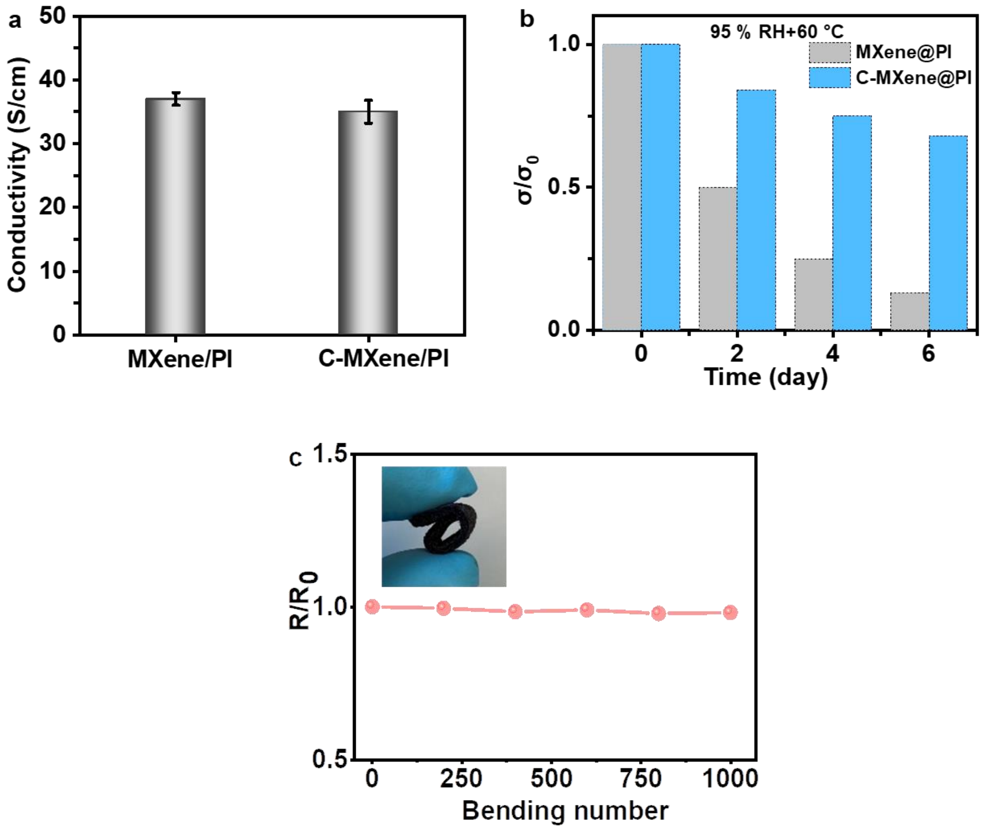

Fig. S7 (**a**) Electrical conductivity of the 14L MXene/PI composites before and after crosslinking treatment. (**b**) Conductivity (σ) change of MXene/PI and C-MXene/PI composite foams after stored in a 95% RH environment and a temperature of 60 °C for different days. In the first day (d = 0), the foams were in a dry state. (**c**) Resistance change of 16L C-MXene/PI composites upon the cyclic bending treatment

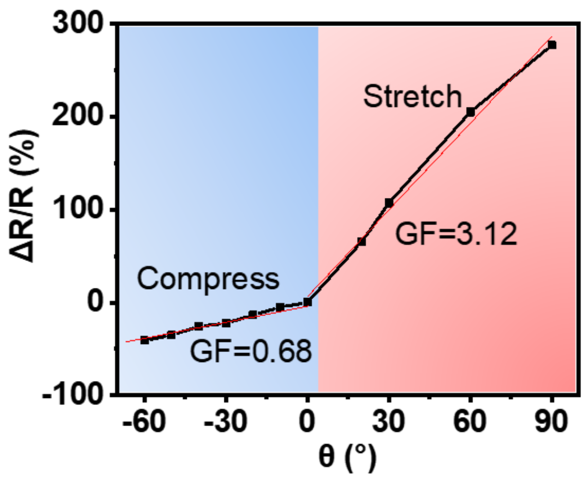

Fig. S8 Bending angle (θ)-resistance change ((ΔR/R) curve shows the sensitivity of the PI foam-based sensors upon bending induced compression and stretching. (Gauge factor is the slope of the curves)

Table S1 EMI shielding performance of typically porous shielding materials

Materials	EMI SE (dB)	Density (mg/cm^3)	Thickness (mm)	SSE (dB·cm^3/g)	SSE/*d* (dB·cm^2/g)	Refs.
			MXene-based porous shields			
C-MXene@PI foam	**43.7**	**41.0**	**0.5**	**1066**	**21317**	
	80.8	**41.0**	**3**	**1971**	**6569**	
	62.52	**48.7**		**1285**	**8567**	
	60.04	**43.0**	**1.5**	**1397**	**9315**	**This work**
	59.17	**41.0**		**1442**	**9612**	
	52.51	**38.0**		**1383**	**9217**	
	45.54	**35.6**		**1278**	**8519**	
Porous MXene film	32	390	0.006	82	137000	[S1]
MXene/CNT aerogel	104	42	3	2476	8254	[S2]
MXene-POSS-NH_2 aerogel	34.5	/	2	/	/	[S3]
MXene/PVA foam	28	10.8	5	2586	5136	[S4]
			Carbon-based porous shields			
CNT/PI foam	41.1	32.1	2	1280.4	6402	[S5]
CNF/PS foam	19		/	/	/	[S6]
CNT/PS foam	19	574	/	33.1	/	[S7]
Graphene/PVDF foam	28		/	/	/	[S8]
Graphene/PMMA foam	19	792	2.4	24	100	[S9]
Graphene/PS foam	29	450	2.5	64.4	258	[S10]
Graphene /PEI foam	9-12.8	~290	2.3	31– 44	135–192	[S11]
Graphene@Fe_3O_4/PEI foam	15-18	400	2.5	37.5–44	150–176	[S12]
CF/PP foam	25	735	3.1	34	109	[S13]

Stainless-steel fiber/PP foam	48	640	3.1	75	242	[S14]
MWCNT/PLA foam	23	299	2.5	77	308	[S15]
MWCNT/PVDF foam	57	750	2	76	380	[S16]
MWCNT/WPU foam	23.0	20	2.3	1148	4991	[S17]
	21.1	39	1	541	5410	
	50.5	120	2.3	401	1743	
MWCNT/cellulose aerogel	20-35	~37-47	2.5	425-944	1700-3776	[S18]
Cellulose aerogel coated with MWCNT	35-40	~69-75	2.5	466-519	1864-2078	
Graphene/PI foam	22	280	0.8	78.6	982	[S19]
Graphene foam based PDMS foam	30	60	1	~500	~5000	[S20]
Graphene foam/CNT/PDMS	75	90	2	833	4165	[S21]
Graphene-coated PU foam	19.9	30.0	20	663.3	3320	[S22]
Graphene foam coated with PEDOT:PSS	69.1	22.1	1.5	3124	20837	[S23]
Graphene based composite aerogel	37	70	3	529	1762	[S24]
Sponged-supported RGO aerogel	24	16.7	12	1437	1198	[S25]
CNT/multi-layered graphene foam	~38	5.8	1.6	6600	~40000	[S26]
Graphene/cellulose-derived carbon foam	47.8	2.8	5.0	16890	33780	[S27]
Graphene/lignin-derived carbon aerogels	23.2	2.5	2	9280	46400	[S28]
	14.3	2.5	1	5720	57200	
Graphene aerogel	22.3	4.5	2	4956	24778	
Carbon foam-CNT/carbon fiber foam	21	12.4	5.0	1690	3370	[S29]
CNT mat	30	/	0.001	/	/	[S30]
CF mat	23	/	0.06	/	/	[S31]
Ni/CF mat	29	/	0.06	/	/	
Fe_3O_4/CNF mat	68	/	0.7	/	/	[S32]
CNF mat	81.1	219	4.6	370	804.3	[S33]
	52.2	134	2.9	390	1361.6	
Graphene/CNA	58.4		2.0	/	/	[S34]
Carbon/Graphene foam	24	721	0.024	33.3	13889	[S35]
Graphene foam	25.2	60	0.3	420.0	14000	[S36]
Phthalonitrile-based carbon foam	51.2	150	2	341.1	1707	[S37]

Commercial carbon foam	40	166	2	241	1250	[S38]
CNT sponge	22	20	2.38	1100	4622	[S39]
Metal-based porous shields						
CuNi foam	15-25	~240	1.5	63–104	420–690	[S40]
CuNi-CNT foam	40-54.6	~230	1.5	174–237	116–1580	
Porous cellulose papers coated with Ag NWs	48.6	530	0.164	91.7	5584	[S41]
Ag NWs/PI foam	17-23.5	22	5	1068-772	2136 -1544	[S42]
Ag NWs/WPU foam	20.0-64.0	8.0	2.3	2500-1422	10970-6184	[S43]
Ag NW@C hybrid sponge	37.9	3.8	1	9921	99214	[S44]
Cu NWs aerogels	~17		9.46	/	/	
Cu NW@ graphene aerogels	52.5	166	9.46	3170	3921.8	[S45]

Table S2 The corresponding power attenuation and transmission efficiency (T) of EM waves for shields with various EMI SE values

EMI SE (dB)	Attenuation (%)	T (%)
10	90	10
20	99	1
30	99.9	0.1
40	99.99	0.01
50	99.999	0.001
60	99.9999	0.0001
70	99.99999	0.00001
80	99.999999	0.000001

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