Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Ultrathin MXene/Aramid Nanofiber Composite Paper with Excellent Mechanical Property for Efficient Electromagnetic Interference Shielding

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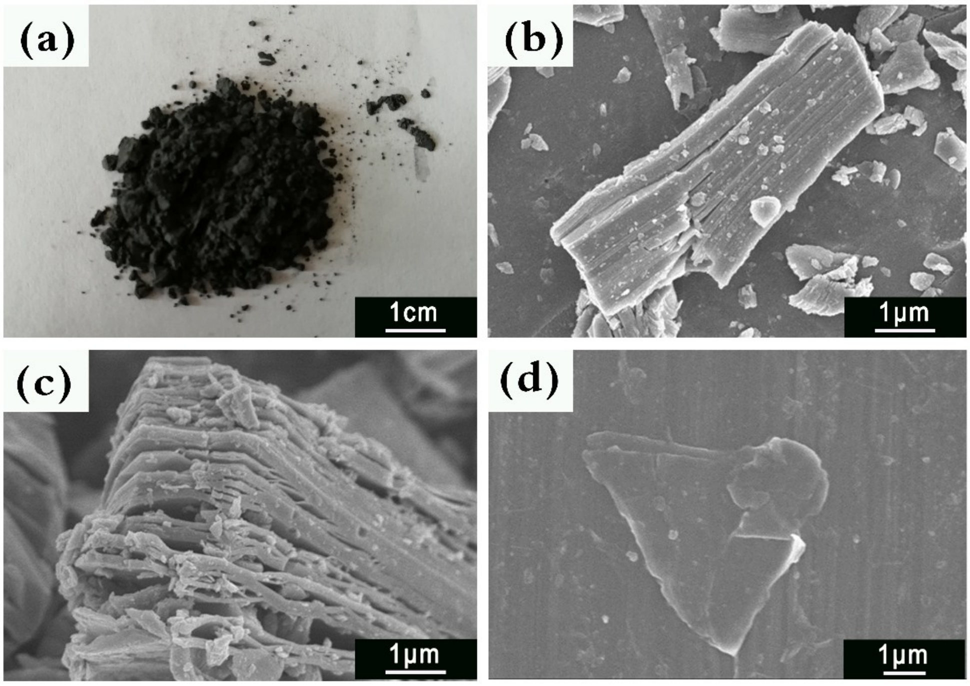

Figure S1. (a) Digital image of Ti_3AlC_2 power. (b) SEM image of Ti_3AlC_2 power. (c) SEM image of m-d-$Ti_3C_2T_x$. (d) SEM image of d-$Ti_3C_2T_x$.

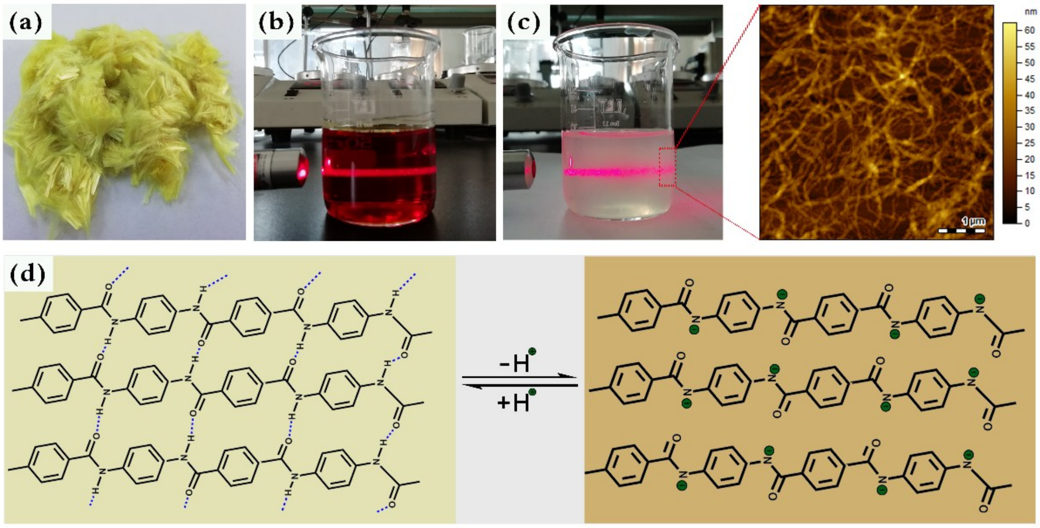

Figure S2. (a) Digital image of PPTA fibers. (b) Tyndall effect of ANFs/DMSO/KOH system. (c) The Tyndall effect of ANFs/water system and AFM micrograph of ANFs. (d) Deprotonation process of PPTA fibers.

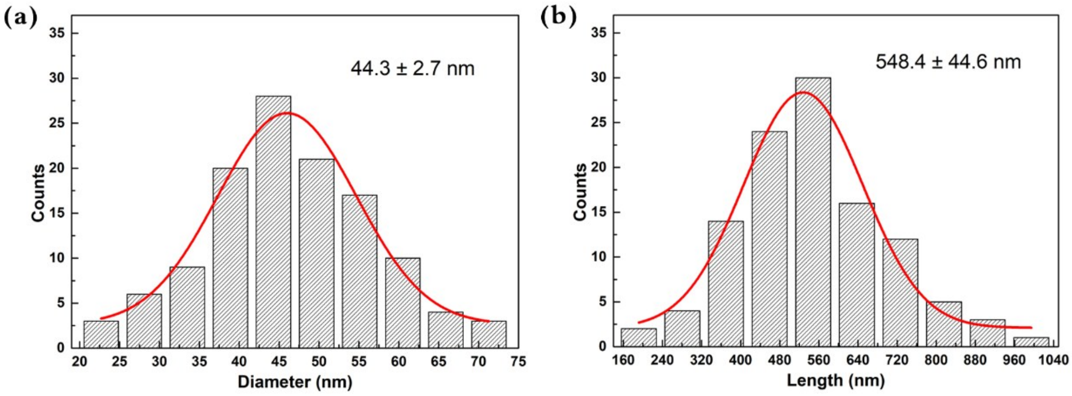

Figure S3. (a)The diameter distribution and (b) the length distribution of ANFs.

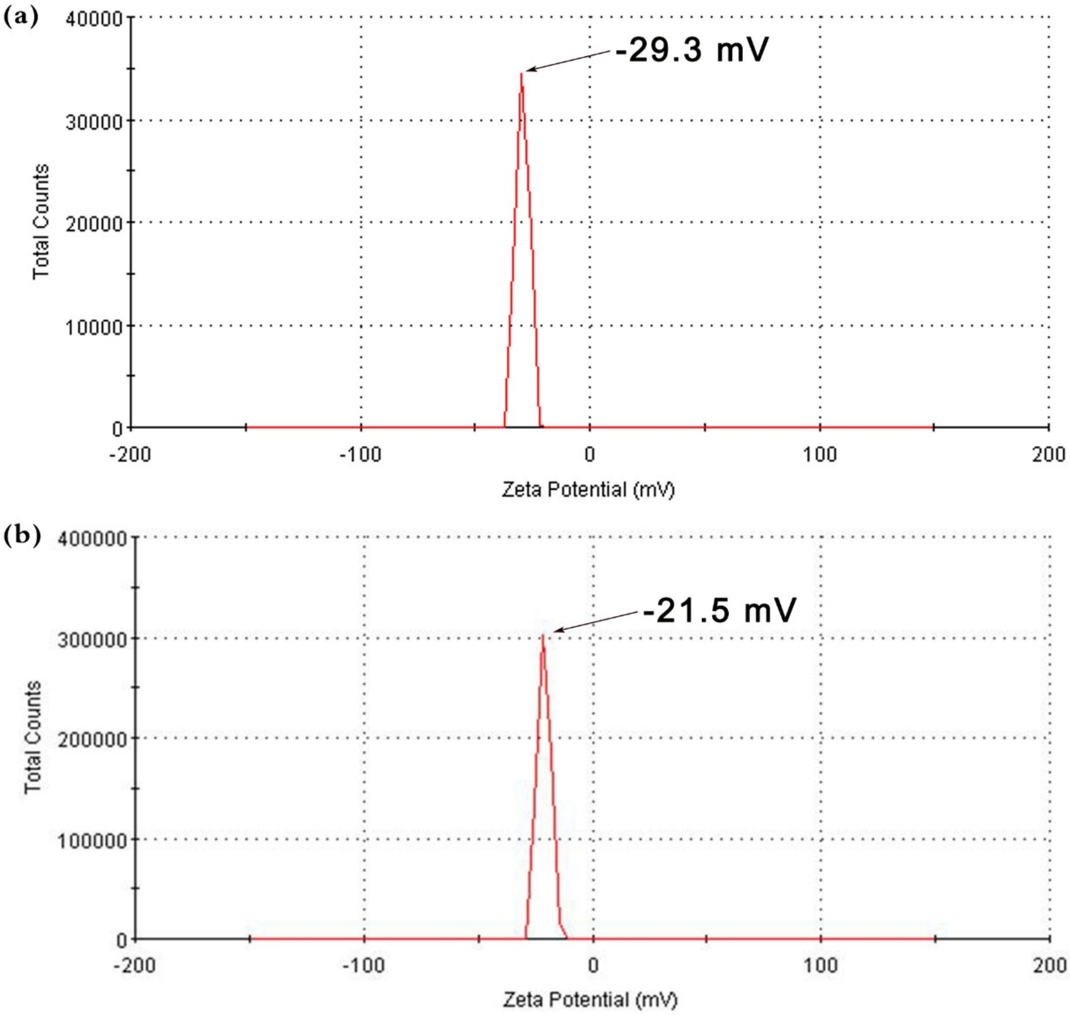

Figure S4. (a) Surface Zeta potential of ANFs at pH 7. (b) Surface Zeta potential of d-$Ti_3C_2T_x$ flakes at pH 7.

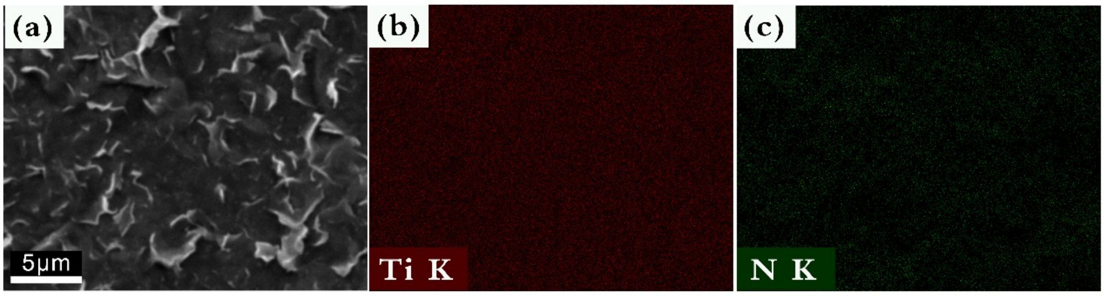

Figure S5. (a) Surface image of d-$Ti_3C_2T_x$/ANFs composite paper (b) EDS mapping of d-$Ti_3C_2T_x$/ANFs composite paper (element Ti) indicating the evenly dispersion of d-$Ti_3C_2T_x$. (c) EDS mapping of d-$Ti_3C_2T_x$/ANFs composite paper (element N) indicating the evenly dispersion of ANFs.

Table S1. Basic parameters of the d-$Ti_3C_2T_x$/ANFs composite paper.

	Samples	Thickness (μm)	Density (g/cm^3)	Resistivity (mΩ·cm)	Conductivity (S·cm^{-1})
1	10 wt% d-$Ti_3C_2T_x$/ANFs	21±1.3	0.910	3389.333	0.295
2	20 wt% d-$Ti_3C_2T_x$/ANFs	23±1.9	0.997	101.903	9.813
3	40 wt% d-$Ti_3C_2T_x$/ANFs	22±2.4	1.188	40.280	24.826
4	50 wt % d-$Ti_3C_2T_x$/ANFs	20±1.4	1.280	14.367	69.606
5	60 wt % d-$Ti_3C_2T_x$/ANFs	17±1.5	1.255	10.032	99.684
6	80 wt % d-$Ti_3C_2T_x$/ANFs	20±1.3	1.453	5.768	173.360
7	90 wt% d-$Ti_3C_2T_x$ /ANFs	15±2.0	1.638	1.592	628.272
8	100 wt % d-$Ti_3C_2T_x$	/	1.852	/	3118.820

Table S2. Mechanical properties of the d-$Ti_3C_2T_x$/ANFs composite paper.

	Materials	**Tensile strength (MPa)**	**Strain at fracture (%)**	**Young's modulus (GPa)**
1	ANFs	164.04	7.30	2.35
2	10 wt% d-$Ti_3C_2T_x$/ANFs	197.09	9.80	2.01
3	20 wt% d-$Ti_3C_2T_x$/ANFs	158.53	8.45	1.87
4	40 wt% d-$Ti_3C_2T_x$/ANFs	136.55	7.23	1.88
5	50 wt% d $Ti_3C_2T_x$/ANFs	83.92	3.96	2.11
6	60 wt% d-$Ti_3C_2T_x$/ANFs	80.14	2.20	2.64
7	80 wt% d-$Ti_3C_2T_x$/ANFs	66.32	1.80	2.68
8	90 wt% d-$Ti_3C_2T_x$ /ANFs	33.07	0.56	2.89
9	100 wt% d-$Ti_3C_2T_x$	Poor mechanical and brittle to test		

Table S3. EMI shielding properties of the d-$Ti_3C_2T_x$/ANFs composite paper.

	Materials	SE_{Total} at 12.4GHz (dB)	SE_A at 12.4GHz (dB)	absorption coefficient at 12.4GHz (%)
1	10 wt% d-$Ti_3C_2T_x$/ANFs	4.89	1.54	31.49
2	20 wt% d-$Ti_3C_2T_x$/ANFs	12.74	7.11	55.80
3	40 wt% d-$Ti_3C_2T_x$/ANFs	19.43	11.31	58.20
4	50 wt% d $Ti_3C_2T_x$/ANFs	23.97	13.40	55.90
5	60 wt% d-$Ti_3C_2T_x$/ANFs	28.54	17.46	61.17
6	80 wt% d-$Ti_3C_2T_x$/ANFs	30.00	17.98	59.93
7	90 wt% d-$Ti_3C_2T_x$ /ANFs	32.84	20.55	62.57
8	100 wt% d-$Ti_3C_2T_x$	38.56	25.49	66.10

Table S4. Properties comparison of the natural nacre, the d-$Ti_3C_2T_x$/ANFs composite paper and other EMI shielding materials.

Sample	Materials	Thickness (mm)	Tensile strength (MPa)	SE (dB)	Reference
[1]	Graphene pellet	0.050	22	60	[1]
[2]	GP/TiO_2-epoxy	0.028	75	11	[2]
[3]	PVA/graphene	0.025	19.2	25.1	[3]
[4]	PVA/GNs/MWCNTs	0.55	82.6	23.51	[4]
[5]	d-$Ti_3C_2T_x$/CNFs	0.0167	135.4	25	[5]
[6]	Cellulose/GP/PPy	0.1	90.8	30	[6]
[7]	RGO/MG/PVA	0.36	62.4	20.3	[7]
[8]	PMMA/graphene	2.4	30	19	[8]
[9]	MWCNT/PPCP	2	41	47	[9]
[10]	PANI/FMWCNT/TPU	1	31.75	31.35	[10]
[11]	PC/MWNT	4	36.4	40	[11]
[12]	PMMA/GP	4	48	19	[12]
[13]	PIPD/PDDA	1.1	21.7	17	[13]
[14]	CNT-RN	0.25	22.2	44.7	[14]
[15]	Graphene paper	0.013	54	52.2	[15]
[16]	MWCNT–PMMA	1.1	23.5	30	[16]
[17]	a-MWCNT/PU	1.5	58.5	29	[17]
[18]	PANI-DBSA	0.8	11.04	55	[18]
[19]	MWCNT/ carbon fabrics	0.2	6.83	38	[19]
[20]	20 wt% d-$Ti_3C_2T_x$/ANFs	0.023	158.5	12.74	This work
[21]	40 wt% d-$Ti_3C_2T_x$/ANFs	0.022	136.5	19.43	
[22]	50 wt% d-$Ti_3C_2T_x$/ANFs	0.020	83.9	23.97	
[23]	60 wt% d-$Ti_3C_2T_x$/ANFs	0.017	80.1	28.54	

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