Supporting Information

A Promising $Ti_3C_2T_x$ MXene/Ni Chain Hybrid with Excellent Electromagnetic Wave Absorption and Shielding Capacity

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some representative materials with MXene/Ni hybrids

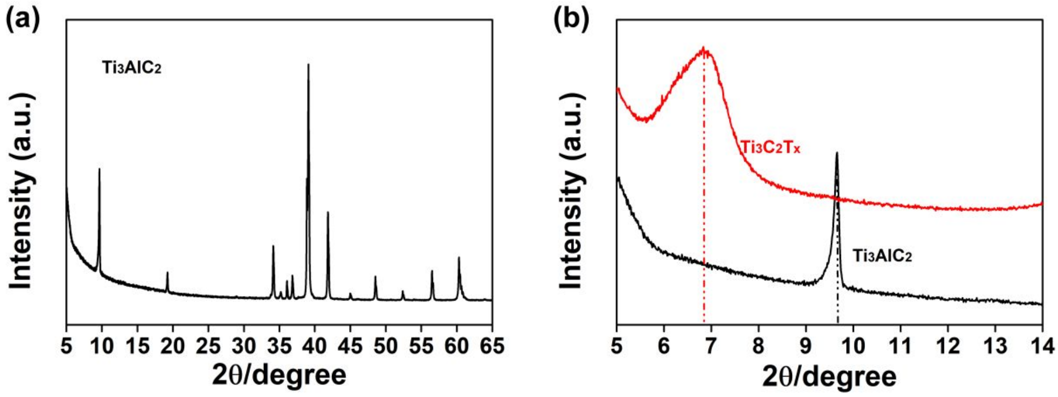

Figure S1. (a) XRD patterns of Ti_3AlC_2 MXenes. (b) Comparison of $Ti_3C_2T_x$ and Ti_3AlC_2 XRD diffraction peaks in low angle regions.

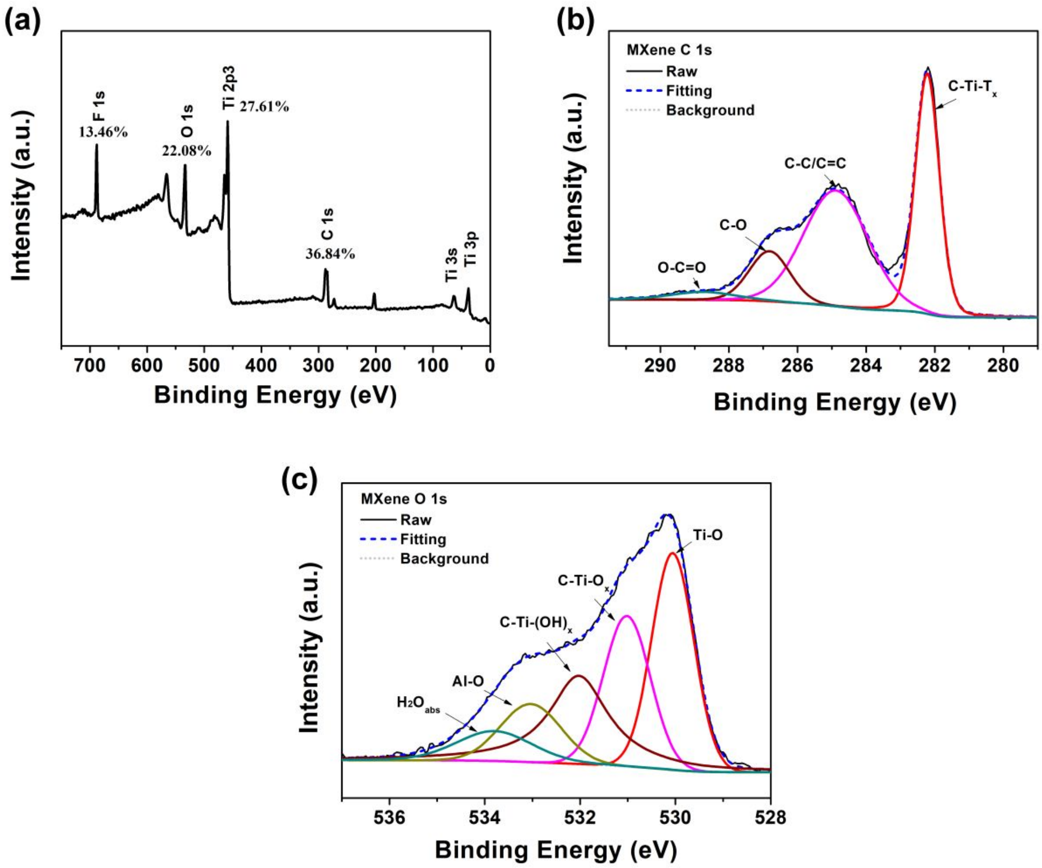

Figure S2. (a) XPS spectra of $Ti_3C_2T_x$ MXenes. (b) C 1s spectra, (c) O 1s spectra.

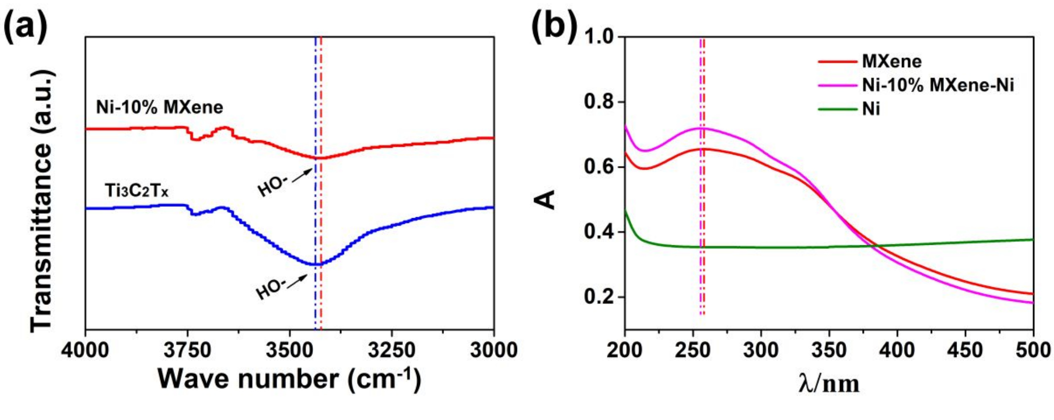

Figure S3. (a) FTIR and (b) UV-vis spectra of Ni-10% MXene and $Ti_3C_2T_x$ MXenes.

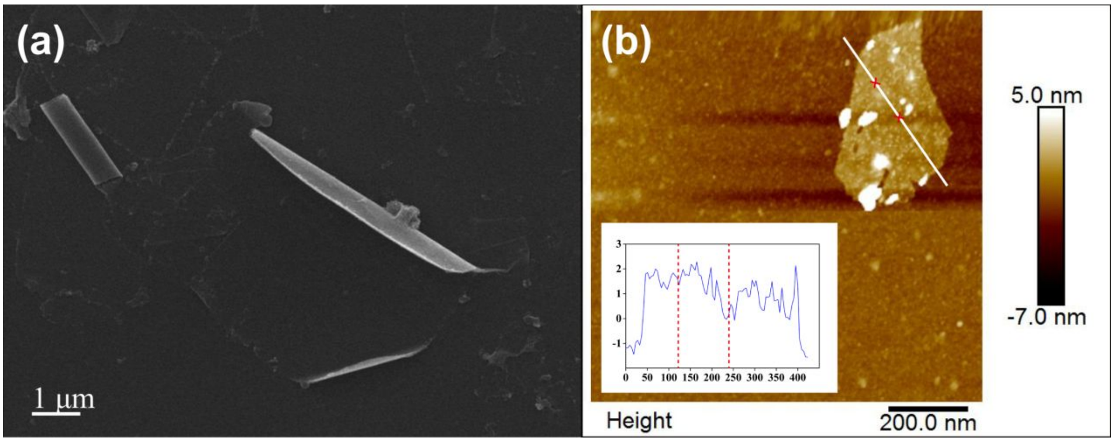

Figure S4. (a) SEM image of $Ti_3C_2T_x$ MXenes. (b) AFM of $Ti_3C_2T_x$ MXenes with the inserted thickness map.

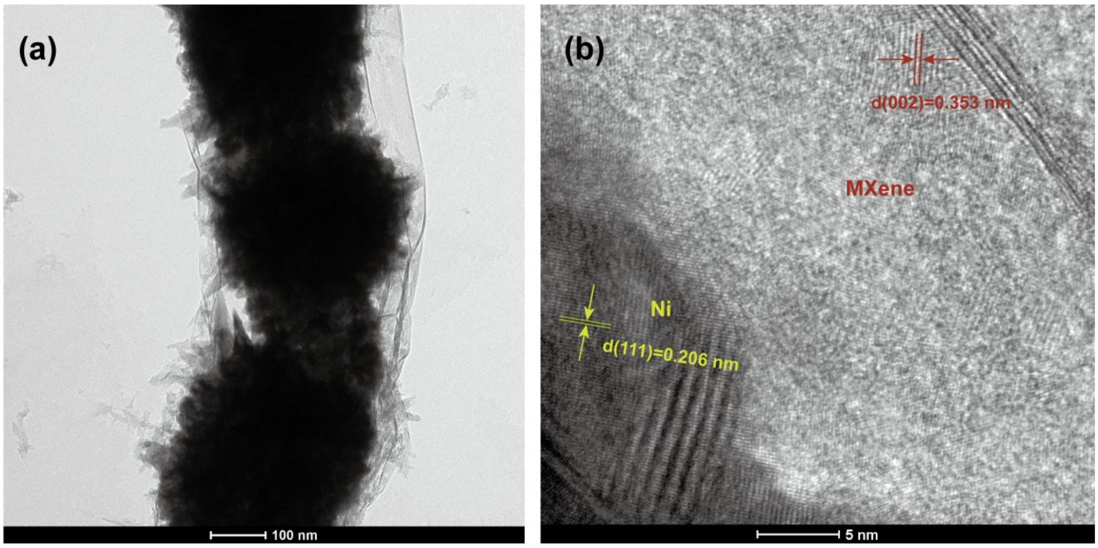

Figure S5. (a) TEM and (b) HRTEM images of MXene/Ni hybrids.

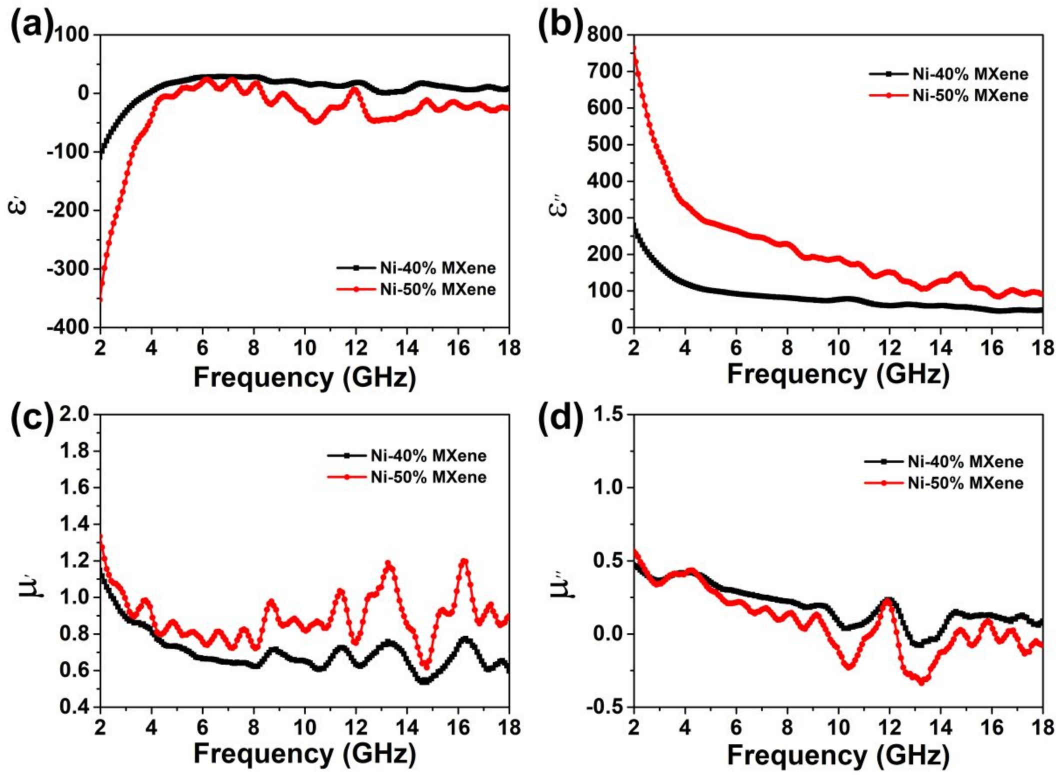

Figure S6. Frequency dependence of (a, c) real and (b, d) imaginary parts of relative (a, b) complex permittivity (ε', ε'') and (c, d) complex permeability (μ', μ'') of Ni-40% MXene and Ni-50% MXene.

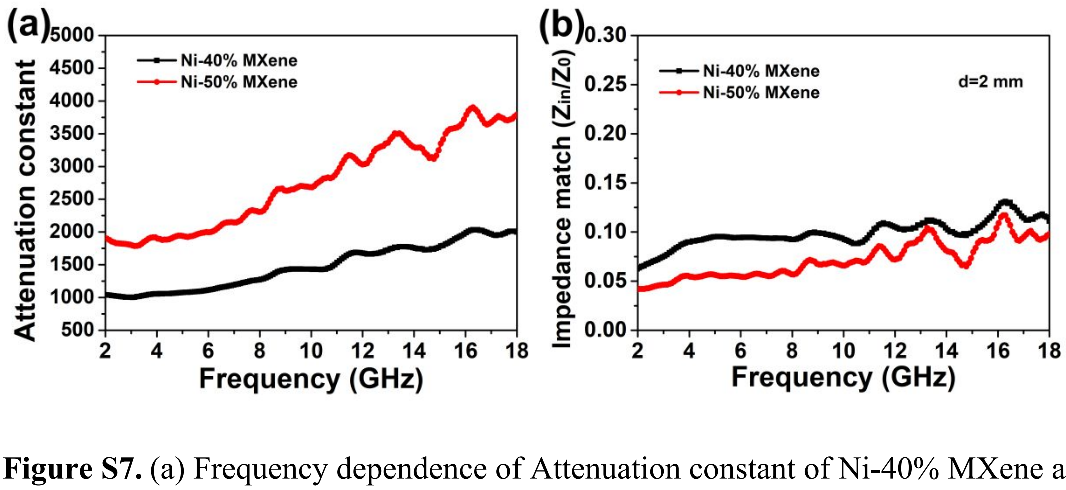

Figure S7. (a) Frequency dependence of Attenuation constant of Ni-40% MXene and Ni-50% MXene, (b) corresponding impedance matching ratio at thickness of 2 mm.

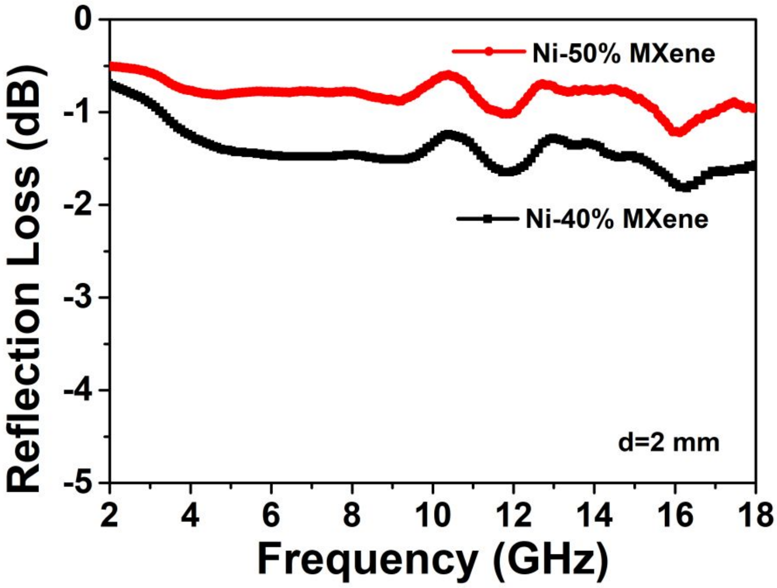

Figure S8. EM reflection loss curves of Ni-40% MXene and Ni-50% MXene hybrids

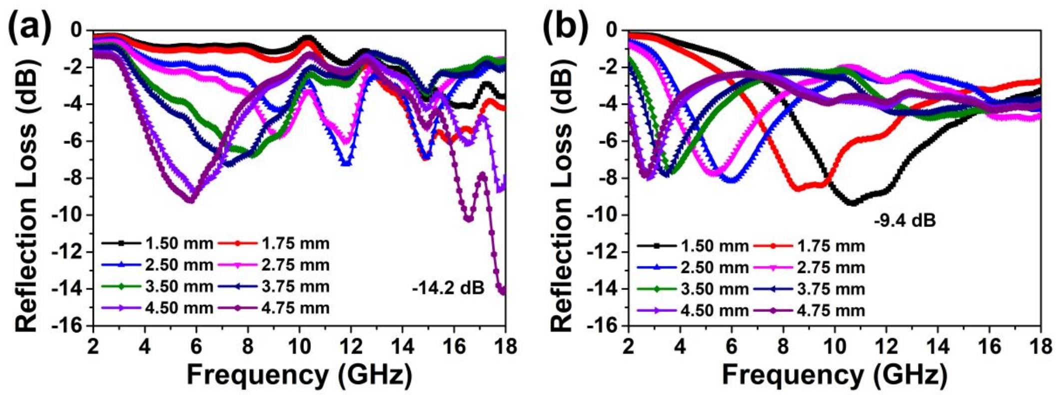

Figure S9. (a) The absorbing curves of the corresponding Ni-5% MXene and (b) Ni-20% MXene hybrids with different thicknesses.

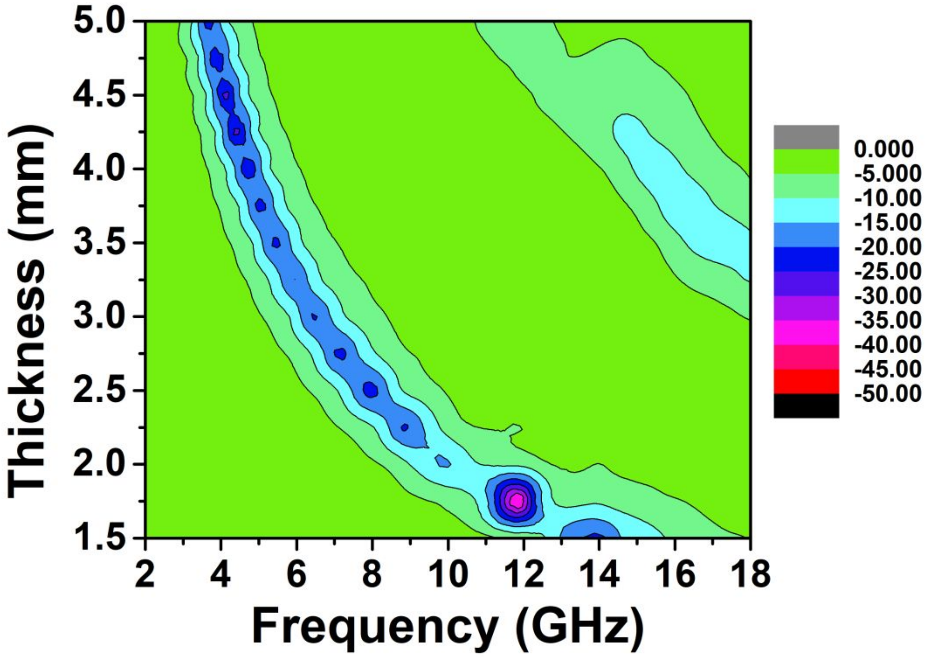

Figure S10. The 2D absorbing curves of the corresponding Ni-10% MXene with different thickness.

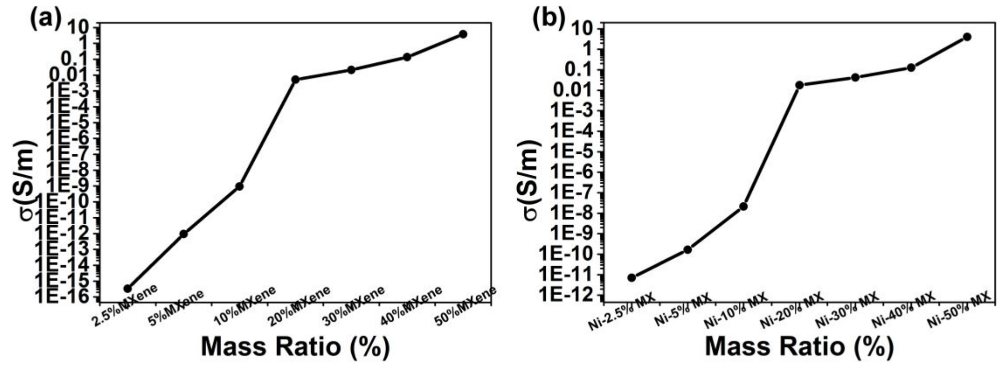

Figure S11. (a) Electrical conductivity of $Ti_3C_2T_x$ MXenes and (b) MXene/Ni hybrids with various MXene contents.

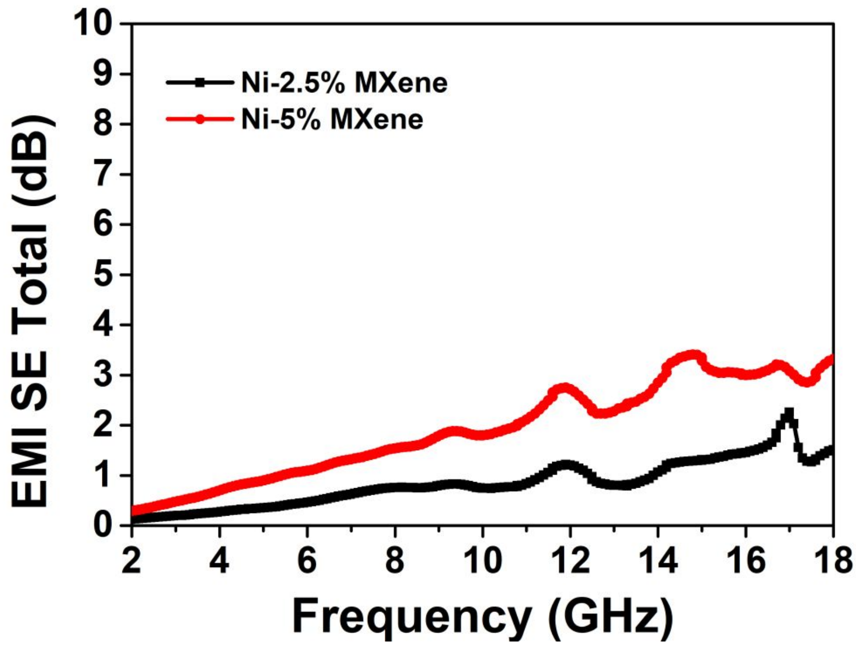

Figure S12. Shielding performance of MXene/Ni hybrids with different $Ti_3C_2T_x$ content of 2.5 wt % to 5 wt %.

Table S1 Comparison of EM wave absorption property of some representative materials with MXene/Ni hybrids

Samples	Filler content	Matrix	RL_{min} value (dB)	RL<10 dB (GHz)	Thickness (mm)	Ref.
$RGO/MnFe_2O_4$	5 wt%	PVDF	-29.0	4.9	3.0	[1]
Fe_3O_4-PEDTO	20 wt%	Wax	-30.0	4.0	4.0	[2]
rGO/Ni	10 wt%	PVDF	-39.0	4.3	2.0	[3]
Co_2Z/Ti_3C_2	30 wt%	PVP	-46.3	1.6	2.8	[4]
$C/TiO_2(Ti_3C_2T_x)$	45 wt%	Wax	-36.0	4.6	1.7	[5]
Annealed $Ti_3C_2T_x$	50 wt%	Wax	-48.4	2.7	1.7	[6]
Ti_3C_2 nanosheets	50 wt%	Epoxy	-17.0	4.2	1.4	[7]

Ti_3SiC_2/Co_3Fe_7	60 wt%	Wax	-31.2	3.1	2.4	8
Annealed MXene/Fe_3O_4	70 wt%	Wax	-45.1	0.9	3.5	9
ZnO-MXenes	75 wt%	Wax	-26.3	1.4	4.0	10
$Ti_3C_2T_x$/C	50 wt%	Wax	-54.6	1.3	4.8	11
Ni-10% MXene hybrid	20 wt%	Wax	-49.9	2.1	1.75	This work

Table S2 Comparison of EM shielding property of some representative materials with MXene/Ni hybrids

Samples	MXene content	Matrix	Thickness (mm)	Frequency range (GHz)	EMI SE_{Total} (dB)	Ref.
$Ti_3C_2T_x$@PS	1.9 vol%	PS	2	8.2-12.4	62.0	12
$Ti_3C_2T_x$	100 wt%	-	0.045	8.2-12.4	92.0	13
Ti_2AlC	100 wt%	-	0.8	8.2-12.4	47.9	14
$Ti_3C_2T_x$	90 wt%	SA	0.0008	8.2-12.4	57.0	13
$Ti_3C_2T_x$	80 wt%	Wax	0.8	8.2-12.4	55.1	14
$Ti_3C_2T_x$	60 wt%	Wax	0.8	8.2-12.4	15.0	14
Annealed $Ti_3C_2T_x$	90 wt%	Wax	1	8.2-12.4	32.0	6
$Ti_3C_2T_x$	90 wt%	Wax	1	8.2-12.4	76.1	6
Layered MXenes	60 wt%	Wax	2	2-18	39.1	15
Ni-50% MXene hybrids	50 wt%	Wax	1.3	2-18	33.8	This work
Ni-50% MXene hybrids	50 wt%	Wax	2.8	2-18	66.4	This work

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