Supplemental Information

Stretchable Wrinkle-Structured Liquid-Metal Sandwich Film Enables Strain-Insensitive Electromagnetic Shielding and Joule Heating

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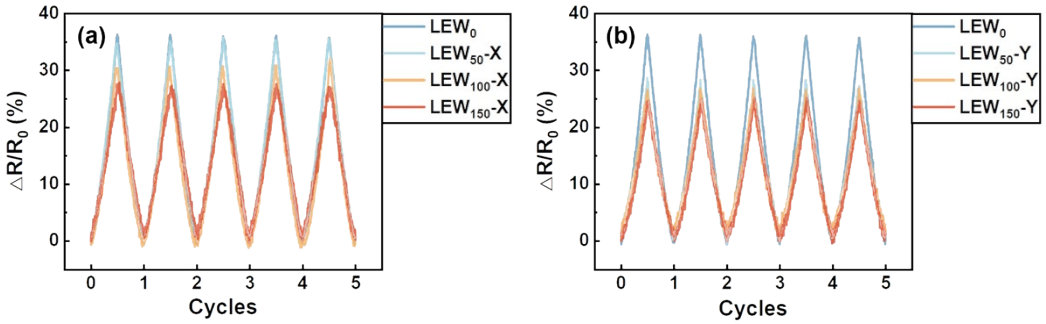

Figure S1. *Resistance change of LEW films in the a) X direction and b) Y direction.*

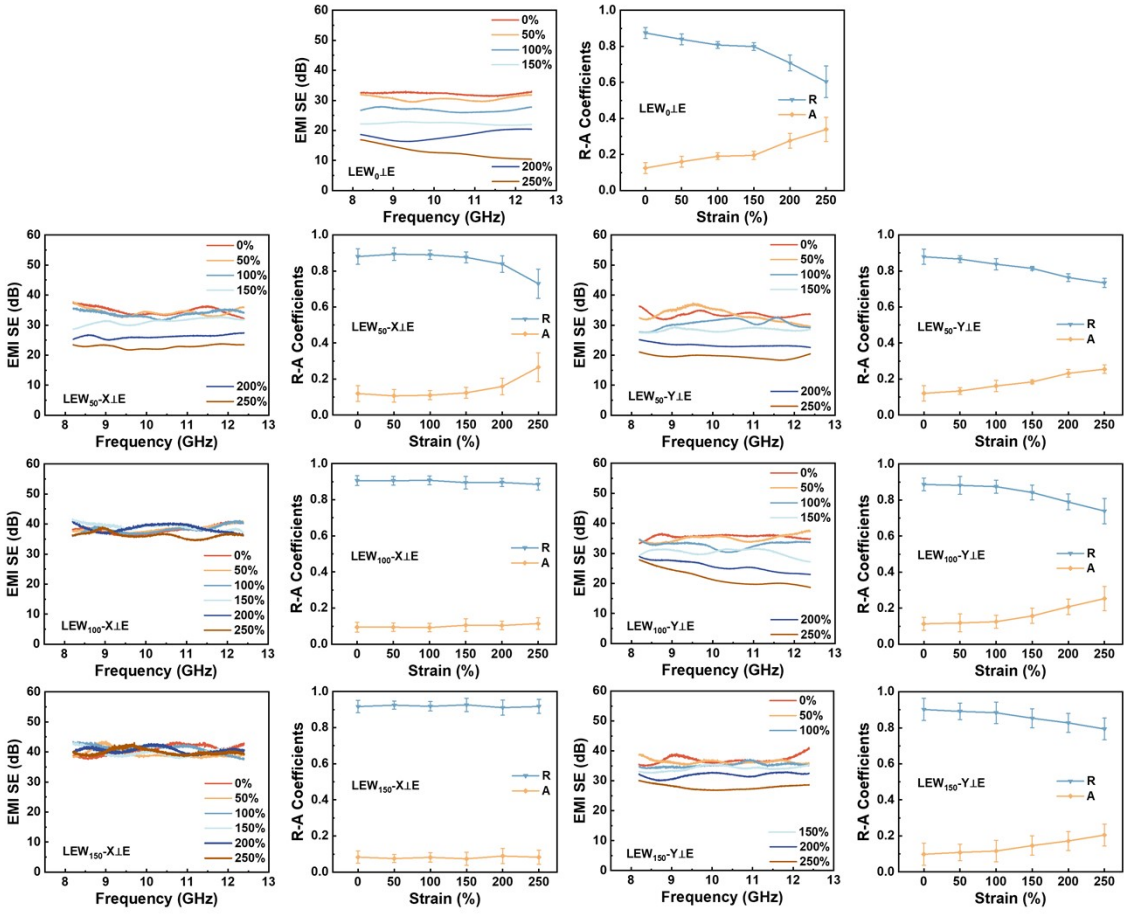

Figure S2. *EMI SE curves and R-A coefficients of $LEW_0 \perp E$, LEW_{50}-X/Y$\perp E$, LEW_{100}-X/Y$\perp E$ and LEW_{150}-X/Y$\perp E$.*

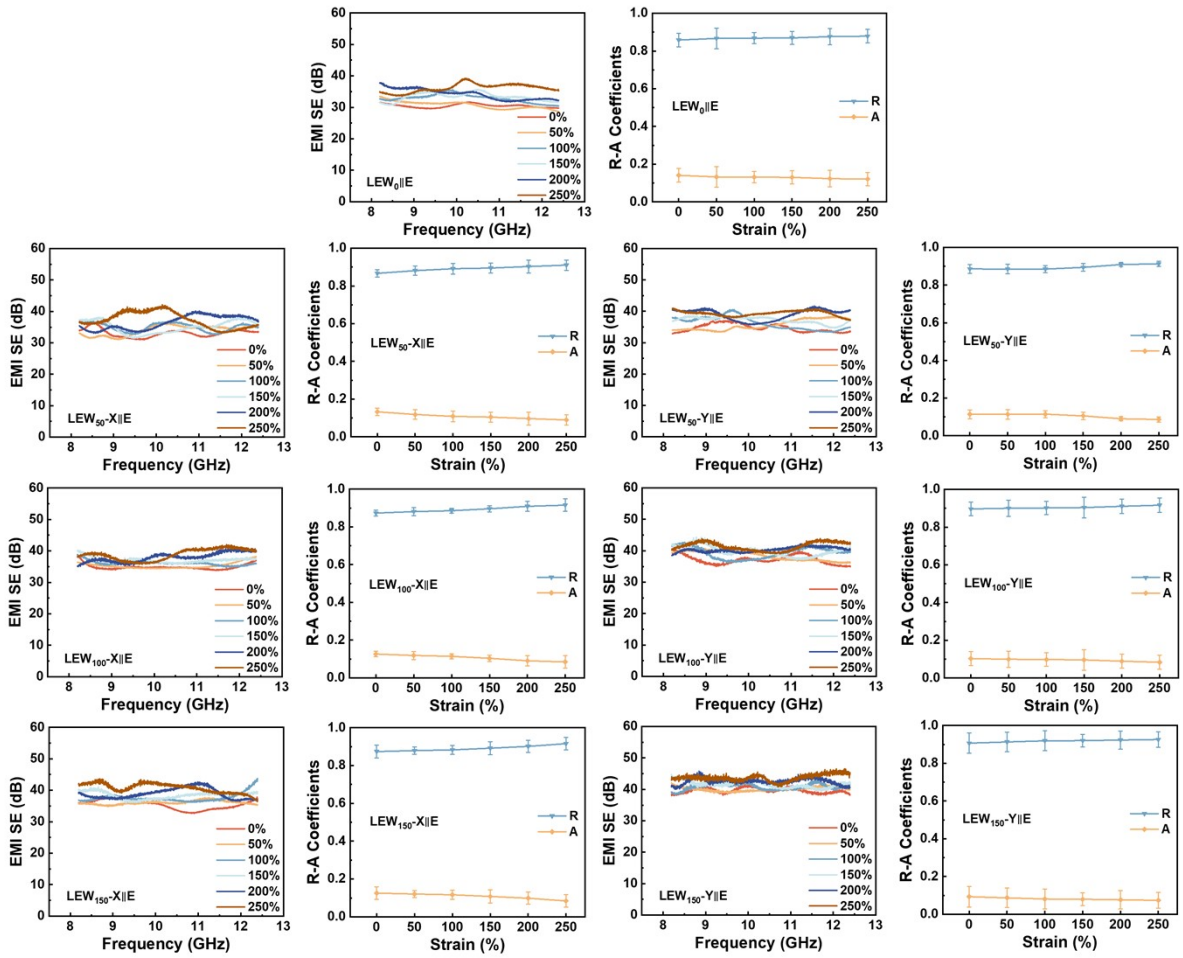

Figure S3. *EMI SE curves and R-A coefficients of LEW_0∥E, LEW_{50}-X/Y∥E, LEW_{100}-X/Y∥E and LEW_{150}-X/Y∥E.*

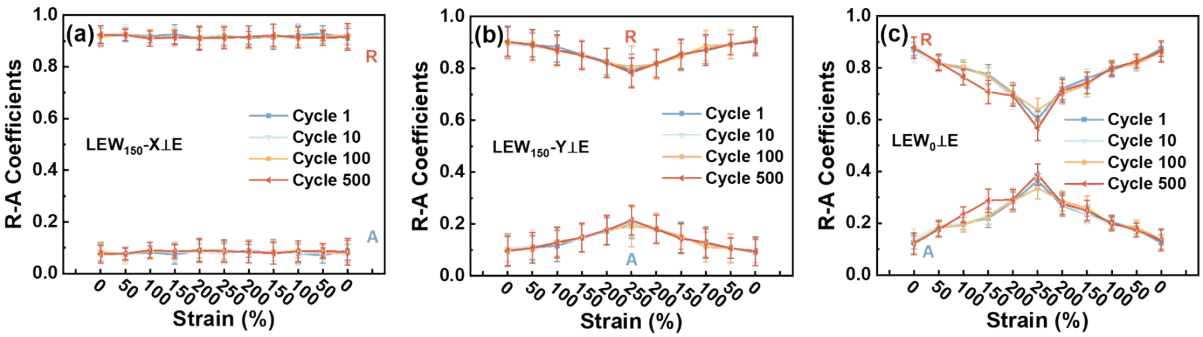

Figure S4. *R-A coefficients of (a) LEW_{150}-X⊥E. (b) LEW_{150}-Y⊥E and (c) LEW_0⊥E during cycles.*

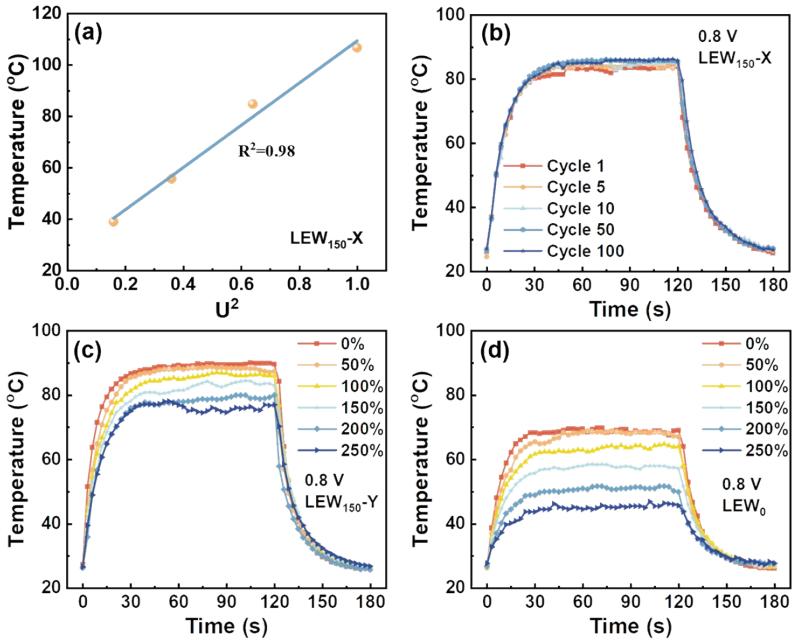

Figure S5. *(a) T_s–U^2 curves of LEW_{150}-X. (b) Multiple heating-cooling cycles of LEW_{150}-X at 0.8 V. Temperature-time curves of (c) LEW_{150}-Y and (d) LEW_0 under different strains.*

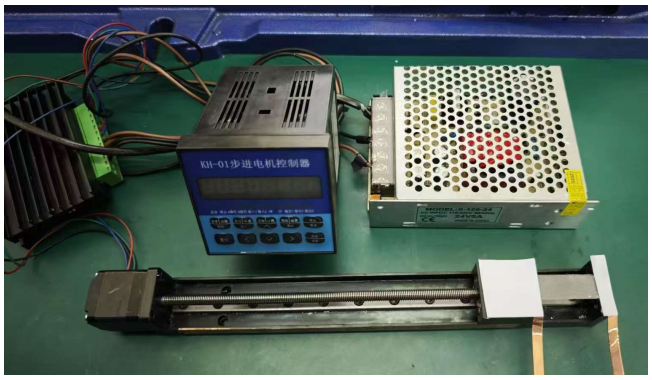

Figure S6. *Digital photograph of homemade stretching device.*

Figure S7. *Digital photograph of EMI SE testing process during stretching.*

Table S1. EMI SE and stretchability of various stretchable EMI shields.

Materials	EMI SE（dB）	Stretch-ability	Normalized SE	Ref.
LM/Ni/Ecoflex film	76-45	0-300%	100-59%	1
LM/Ecoflex foam	57-85	0-400%	100-149%	2
PDMS/LM textile	72.6-52.5	0-50%	100-72%	3
TPU/PDA/AgNPs/LM textile	112.8-85.9	0-60%	100-76%	4
LM/CNT/Gelatin/PAM hydrogel	37.4-17	0-500%	211-96%	5
LM/Ag/SEBS textile	75.3-31.7	0-300%	100-42%	6
LM/Fe/Ecoflex film⊥E	20.6-80.7	0-400%	100-392%	7
LM/SPU	39.6-72	0-300%	100-182%	8
GnP/PU film	21-41	0-130%	100-195%	9
TPU/MXene wrinkled fabric	31.4-21	0-70%	100-67%	10
Cu/rubber conductive microcoils	35.7-10.7	0-75%	136-41%	11
XNBR/Li-TFSI/PEDOT/PSS film	46-28	0-100%	100-61%	12
SDEP/LM foam	66.7-26.1	0-500%	100-39%	13
DSWCNT/Latex film⊥E	36-20.1	0-200%	100-56%	14
DSWCNT/Latex film∥E	28.3-41.1	0-200%	100-145%	14
LM/TPU foam∥E	50.6-57.9	0-200%	100-114%	15

LM/TPU film∥E	58.1-63.1	0-400%	100-108%	16
LM/PDMS mesh∥E	16.7-24.2	0-60%	100-145%	17
LM/PDMS mesh⊥E	16.7-10.2	0-60%	100-63%	17
APU/CNT foam	35.6-31.8	0-30%	102-91%	18
LM/PDMS film∥E	43.4-44.9	0-75%	97-100%	19
3D LM/Ecoflex∥E	41.5-81.6	0-400%	100-197%	20
LM/PDMS lattice	36.8-37.3	0-100%	99.4-100%	21
3D core-shell LM/PDMS	50-43.5	0-50%	100-87%	22
LEW_{150}-X⊥E	**39.3-41.1**	**0-250%**	**97-101.2%**	**This work**
LEW_{150}-X∥E	**35.3-40.7**	**0-250%**	**100-115%**	**This work**

Table S2. Steady-state temperature and stretchability of various stretchable electric heaters.

Materials	**Temperature (℃)**	**Stretch-ability**	**Normalized temperature**	**Ref.**
TPU/PDA/AgNPs/LM textile	65.2-52.1	0-60%	100-79%	4
TPU/MXene wrinkled fabric	84-73	0-50%	100-87%	10
DSWCNT/Latex film	70-60	0-100%	100-86%	14
LM/TPU foam	62-53.9	0-200%	100-87	15
LM/TPU film	60-47	0-100%	100-78%	16
LM/PDMS mesh	91.1-94.9	0-60%	100-104%	17
APU/CNT foam	81-65	0-30%	100-80%	18
LM/PDMS film	100-95	0-75%	100-95%	19

PDMS/AgNW film	85-74	0-100%	100-87%	23
S-CNTs/Elastomer nanocomposite	160-30	0-200%	100-19%	24
Graphene/Ecoflex nanocomposite	50-30	0-100%	100-60%	25
Ag/MWCNTs/rubber film	35-32	0-40%	100-91%	26
semiconducting polymer-based aerogel film	42.2-40	0-75%	100-95%	27
LM@CIP WED	41.4-43.4	0-50%	100-105%	28
AgNW/SBS meshes	36.5-32.7	0-50%	100-90%	29
AgNW percolation network	55-40	0-30%	100-72%	30
rubber/graphene	163-115.2	0-100%	100-71%	31
LEW_{150}-X	**85.1-72.8**	**0-250%**	**100-86%**	**This work**
LEW_{150}-Y	**89.4-75.4**	**0-250%**	**100-84%**	**This work**

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