**Supplementary Information**

**Gradient carbonyl-iron/carbon-fiber reinforced composite metamaterial for ultra-broadband electromagnetic wave absorption by multi-scale integrated design**

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**Fig. S1.** Simulated reflection loss spectra of electromagnetic wave absorbing composites with different material combinations: (a) the gradient multilayer absorbing composite; (b) the proposed GACM.

**Table S1.** The optimized material parameters of the proposed GACM

|  |  |  |
| --- | --- | --- |
| Layer name | Material number | Layer thickness / mm |
| Layer-1 (Bottom layer) | 8# | 2 |
| Layer-2 (Middle bottom layer) | 7# | 2 |
| Layer-3 (Middle top layer) | 6# | 2 |
| Layer-4 (Top layer) | 5# | 2 |



**Fig. S2.** Simulated reflection loss spectra of the proposed GACM with different geometry parameters: (a) *a*2, (b) *a*3, (c) *a*4, (d) *d*2, (e) *d*3, and (f) *d*4.