Supporting Information

Melamine/ZIF-67-derivatives based Z-shaped Metamaterial for Ultra-broadband Microwave Absorber: Design from Microscopic Dielectric-Magnetic Coupling Effect to Macroscopic Artificial Engineered Structure

Xiaochi Lu *[a], Zhuokang Zhou [a], Xinchun Li [a], Yu Chen [c], Litao Lin [c], Wenquan Zhong [a], Wenyu Cao [a], Zhuangzhi Liu [a], Qijun Xian [a], Ziyang Dai [b], Panpan Zhou [d], Bin Quan *[c]

[a] *College of Electronic and Optical Engineering & College of Flexible Electronics (Future Technology), Nanjing University of Posts and Telecommunications, Nanjing 210023, China.*

[b] *School of Materials Science and Engineering, Yancheng Institute of Technology. Yancheng, 224051, China*

[c] *Jiangsu Key Laboratory of New Energy Devices & Interface Science, School of Chemistry and Materials Science, Nanjing University of Information Science & Technology, Nanjing 210044, China*

[d] *School of Electronic and Information Engineering, Suzhou University of Technology, Changshu, 215500, China*

(*) corresponding author: xiaochilu@njupt.edu.cn (Xiaochi Lu), binquan@nuist.edu.cn (Bin Quan)

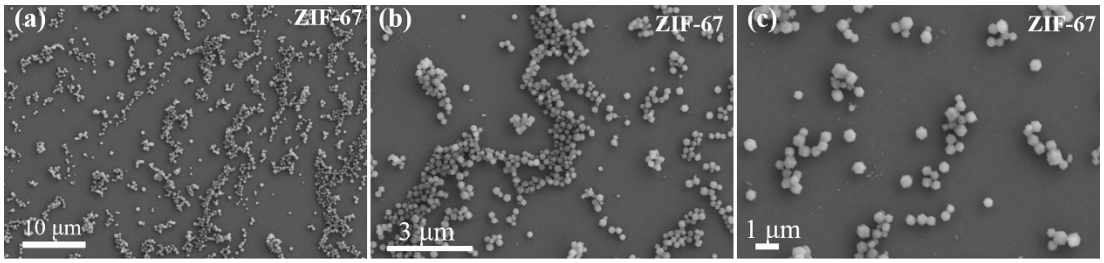

Fig. S1 SEM images of ZIF-67 particles.

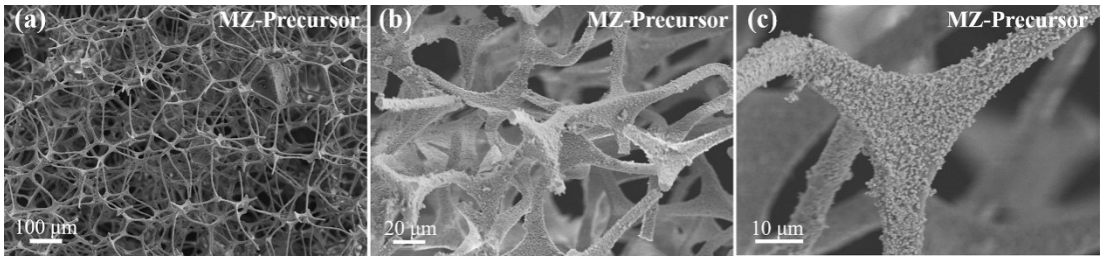

Fig. S2 SEM images of ZIF-67 particles attached to melamine foam skeleton.

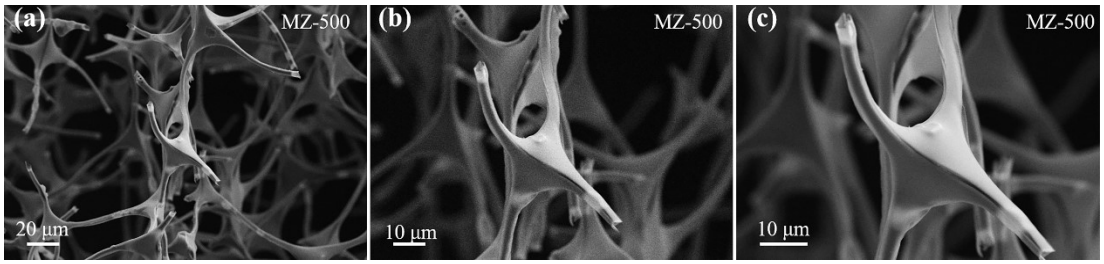

Fig. S3 SEM images of composite material with ZIF-67 particles attached to melamine foam framework after 500 °C heat treatment.

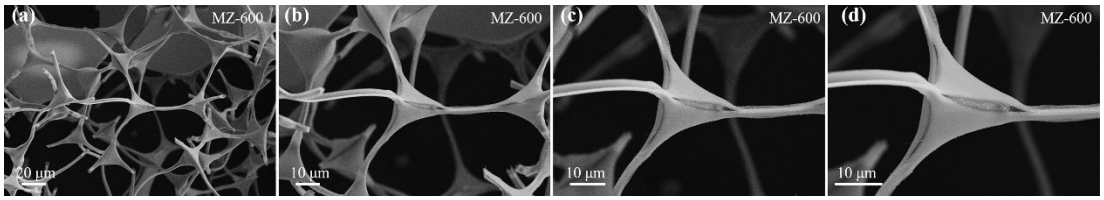

Fig. S4 SEM images of composite material with ZIF-67 particles attached to melamine foam skeleton after 600 °C heat treatment.

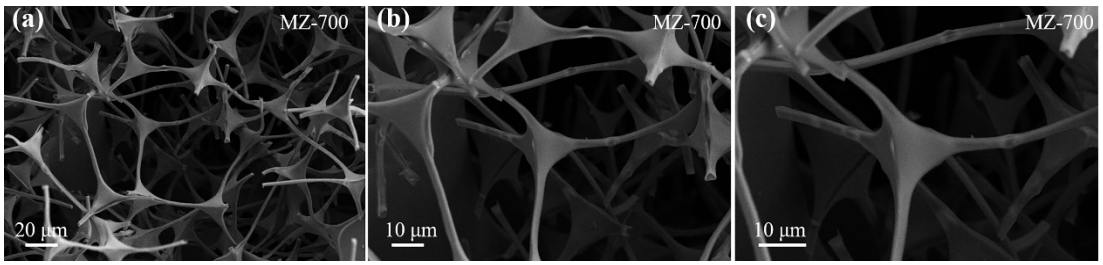

Fig. S5 SEM images of composite material with ZIF-67 particles attached to melamine foam skeleton after 700 °C heat treatment.

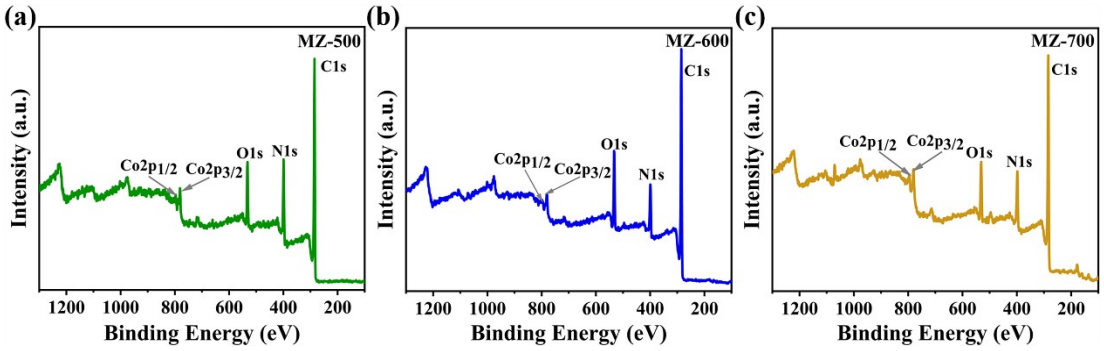

Fig. S6 XPS spectra of MZ-500/600/700.

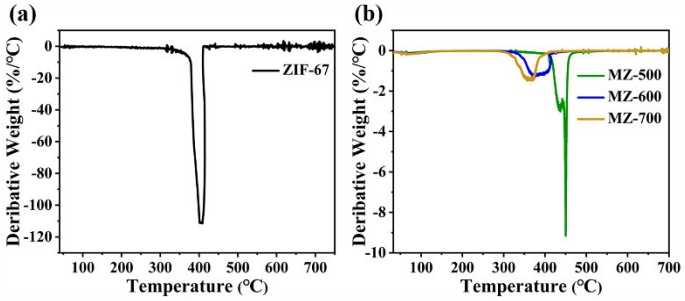

Fig. S7 DTG diagrams of ZIF-67, MZ-500/600/700.

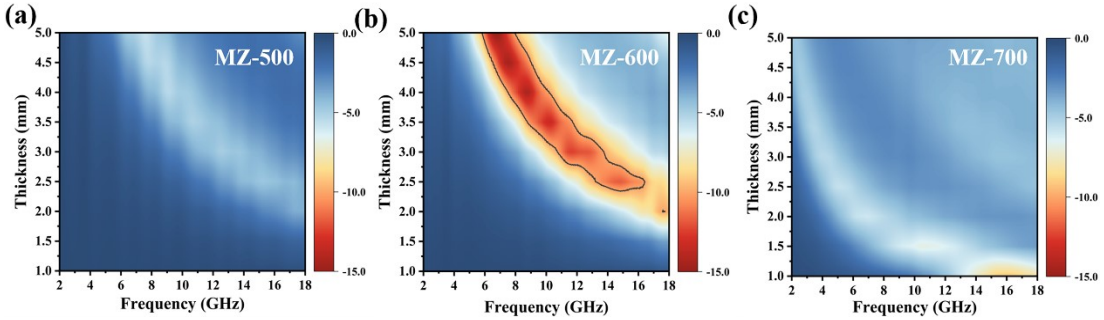

Fig. S8 2D plane view of RL calculation for MZ-500/600/700.

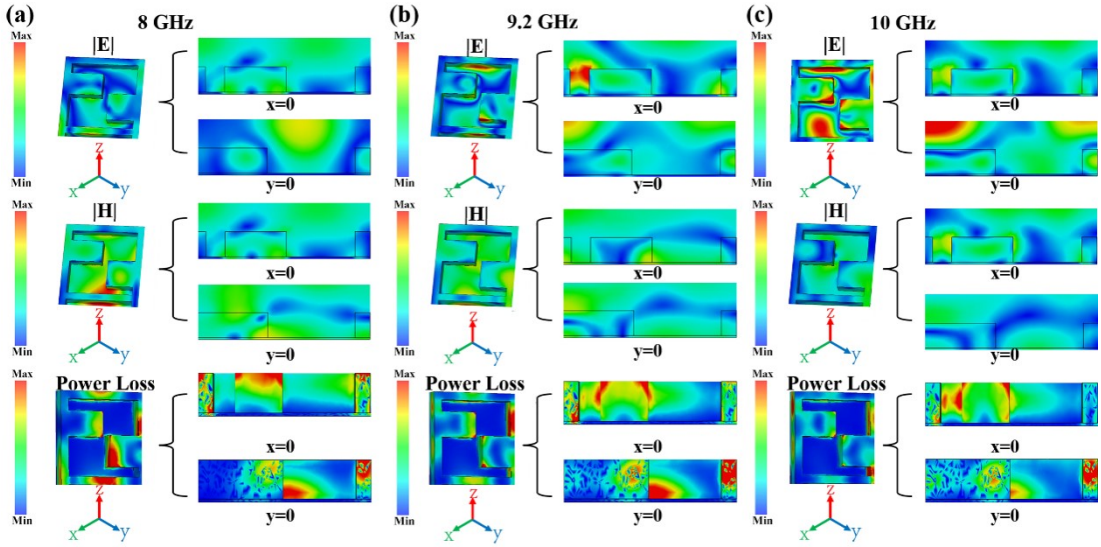

Fig. S9 Calculated electric and magnetic fields and power loss plot of metamaterials at 8 GHz, 9.2 GHz, 10 GHz.

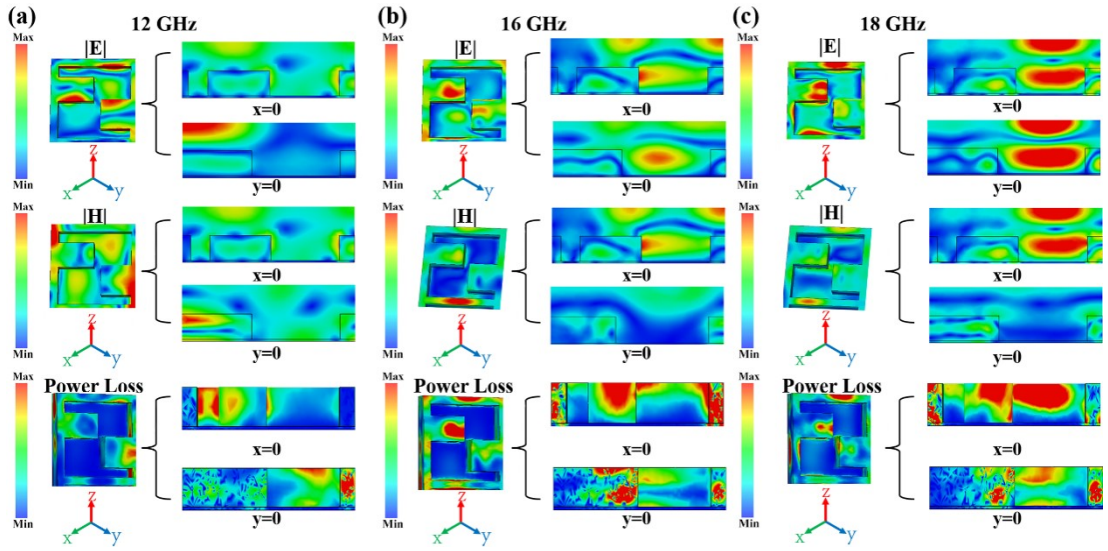

Fig. S10 Calculated electric and magnetic fields and power loss plot of metamaterials at 12 GHz, 16 GHz, 18 GHz.

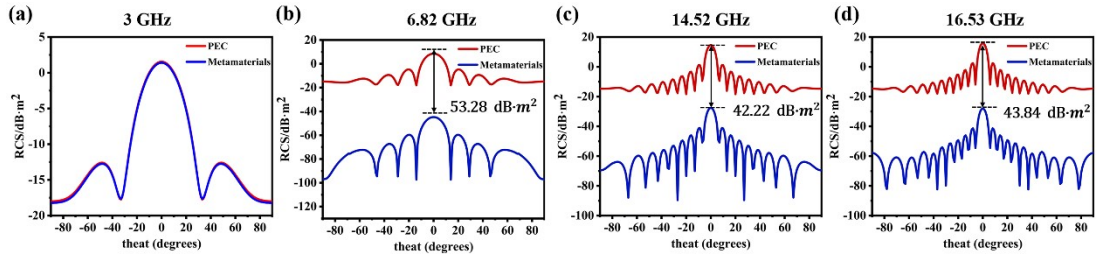

Fig. S11 Calculated RCS of metamaterials at 3 GHz, 6.82 GHz, 14.52 GHz, and 16.53 GHz.

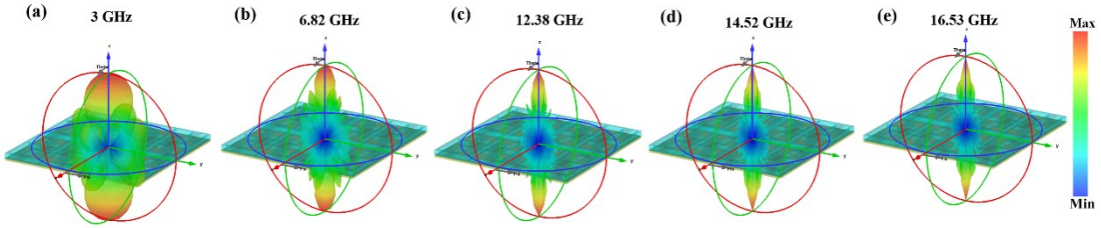

Fig. S12 Calculated direction diagram of metamaterials at 3 GHz, 6.82 GHz, 14.52 GHz, and 16.53 GHz.