Electronic Supplementary Information (ESI)

Refractory metamaterial absorber for ultra-broadband, omnidirectional and polarization-independent absorption in the UV-NIR spectrum

Yijia Huang,[a,b,‡] Ling Liu,[a,b,‡] Mingbo Pu,[a] Xiong Li,[a] Xiaoliang Ma[a] and Xiangang Luo*[a]

[a]State Key Laboratory of Optical Technologies on Nano-Fabrication and Micro-Engineering, Institute of Optics and Electronics, Chinese Academy of Science, P.O. Box 350, Chengdu 610209, China

[b]University of Chinese Academy of Sciences, Beijing 100049, China

‡ These authors contributed equally to this work.

*Email: lxg@ioe.ac.cn

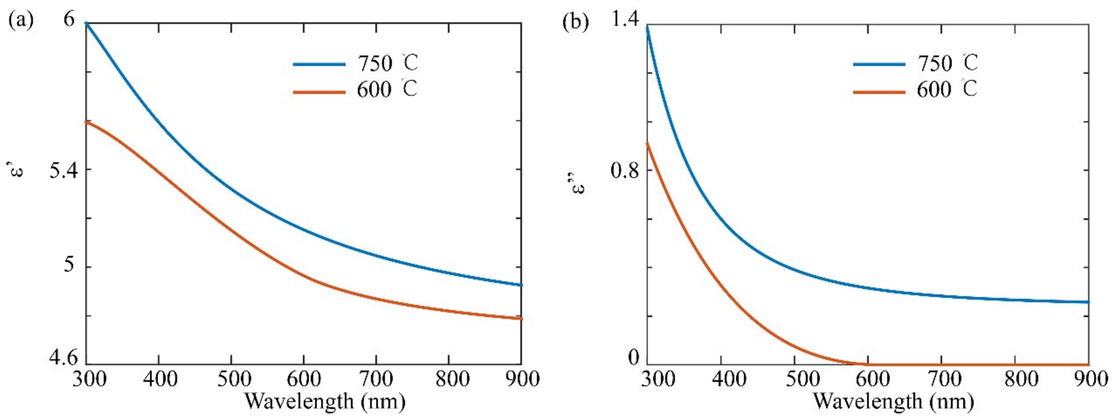

Fig. S1 The permittivity of SiC. (a) The real part of permittivity for SiC at different temperatures. (b)The imaginary counterparts at the same temperatures. In the simulation, we used the parameters at 600℃ as the magnetron sputtering works at this temperature. Obviously, the permittivity of SiC changed very little when the temperature raised from 600℃ to 750℃, which indicates that our MPA can work efficiently even at high temperature conditions.

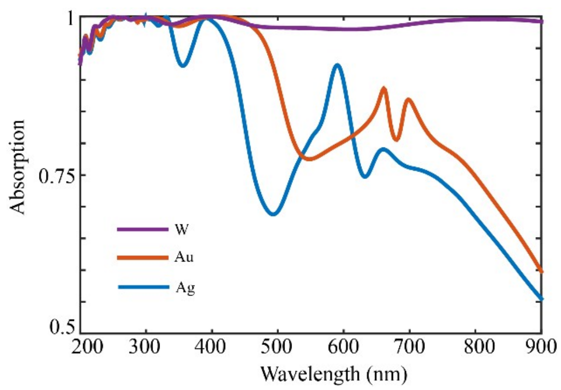

Fig. S2 The absorption of the proposed structure with different materials as the lossy metal. As the ε'' of W is much larger than that of Ag and Au at long wavelengths, the field dissipation is remarkably enhanced at these regions. The parameters for Au and Ag are from Palik.

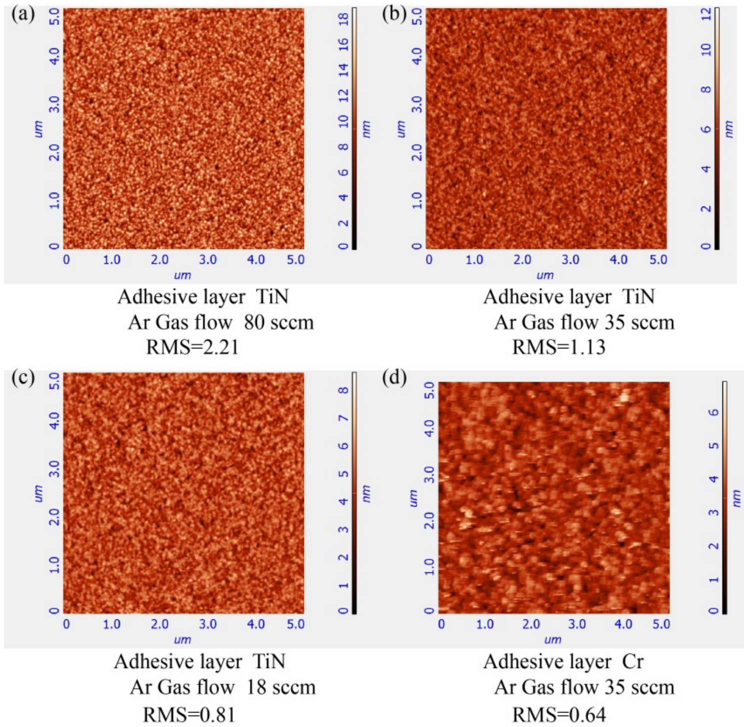

Fig. S3 The Root Mean Square (RMS) of the surface roughness of W film at different conditions. The constitute material of the adhesive layer, the Ar gas flow in the chamber and the value of RMS at each condition are labelled below the figures. We chose the fabrication parameters in Figure S4(d) for our device as it has the minimal RMS.

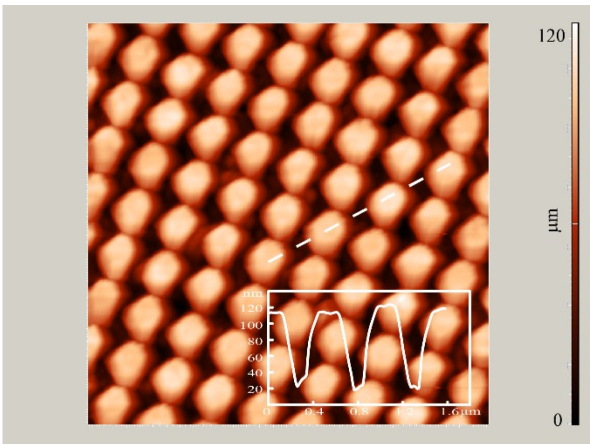

Fig. S4 The AFM of the W cylinder array and the measured contours of its cross-section. Obviously, the configuration of the structure matches the simulation quite well. The pattern of the cylinder array is obtained by interference lithography and it can be inferred that this process is suitable for the fabrication of such device.

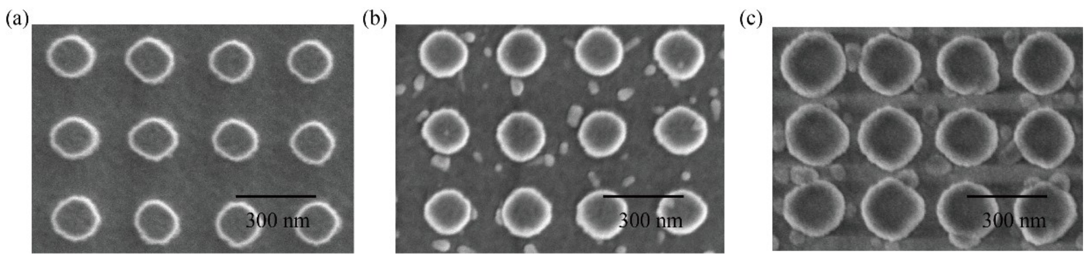

Fig. S5 The SEM images for W, W-SiC and W-SiC-SiO_2 nanostructures. After coating with different materials, the cylinders become bigger in diameter while keep their round shapes.

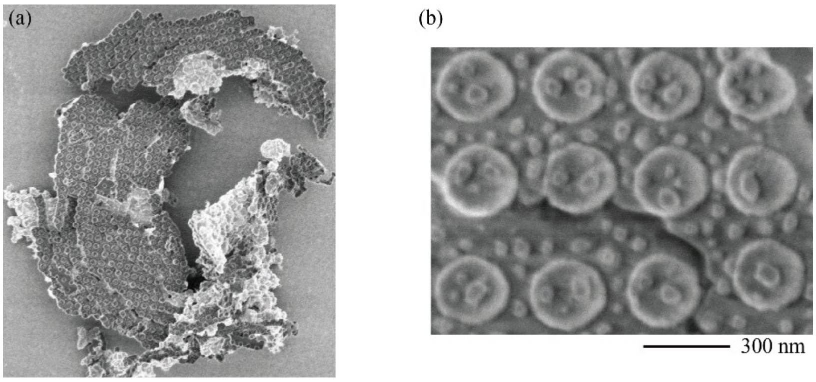

Fig. S6 (a)The SEM image of the MPA after annealing at 800℃ in air. Owing to the thermal expansion mismatch between the films and the substrate, the nanostructured layers shrank and separated from the substrate. While from the zoomed in image shown in (b), the nanostructured configurations are invariant under such high temperature. Therefore, we believe that by changing substrate with matched thermal expansion coefficient with W layer or controlling the annealing process properly, our MPA can work efficiently under higher temperatures.