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Simultaneous realization of highly efficient electromagnetic interference shielding and human motions detection in carbon fiber felts decorated with silver nanowires and thermoplastic polyurethane

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1. The AgNWs contents in TA-*x*

The exact AgNWs content in the prepared TA-*x* were obtained by measuring the weight of pure CFF and TA-*x*, and the corresponding results were shown in Fig. S1. The AgNWs content in TA-*x* increases with the increasing dipping-drying cycles. The actual contents of AgNWs in TA-1, TA-3, TA-5, TA-7 and TA-9 are 0.81 wt%, 2.61 wt%, 3.89 wt%, 5.35 wt% and 7.85 wt%, respectively.

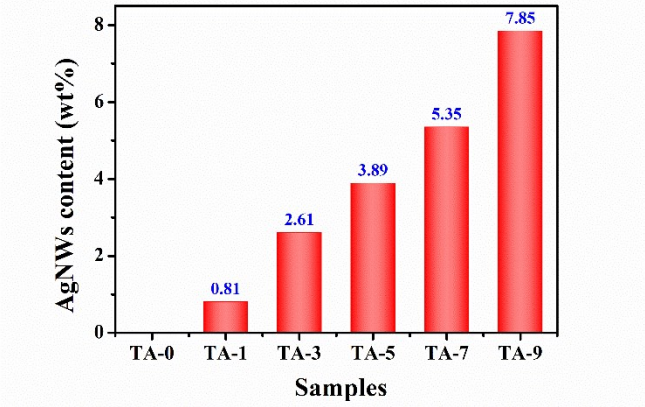

Fig. S1. The AgNWs contents in TA-*x*.

2. SEM of CFF covered by a thin TPU layer

The SEM images in Fig. S2 present an obvious thin TPU layer covering on the surface of CFF (TA-0). The surface of CFF shows no significant change with the introduction of TPU.

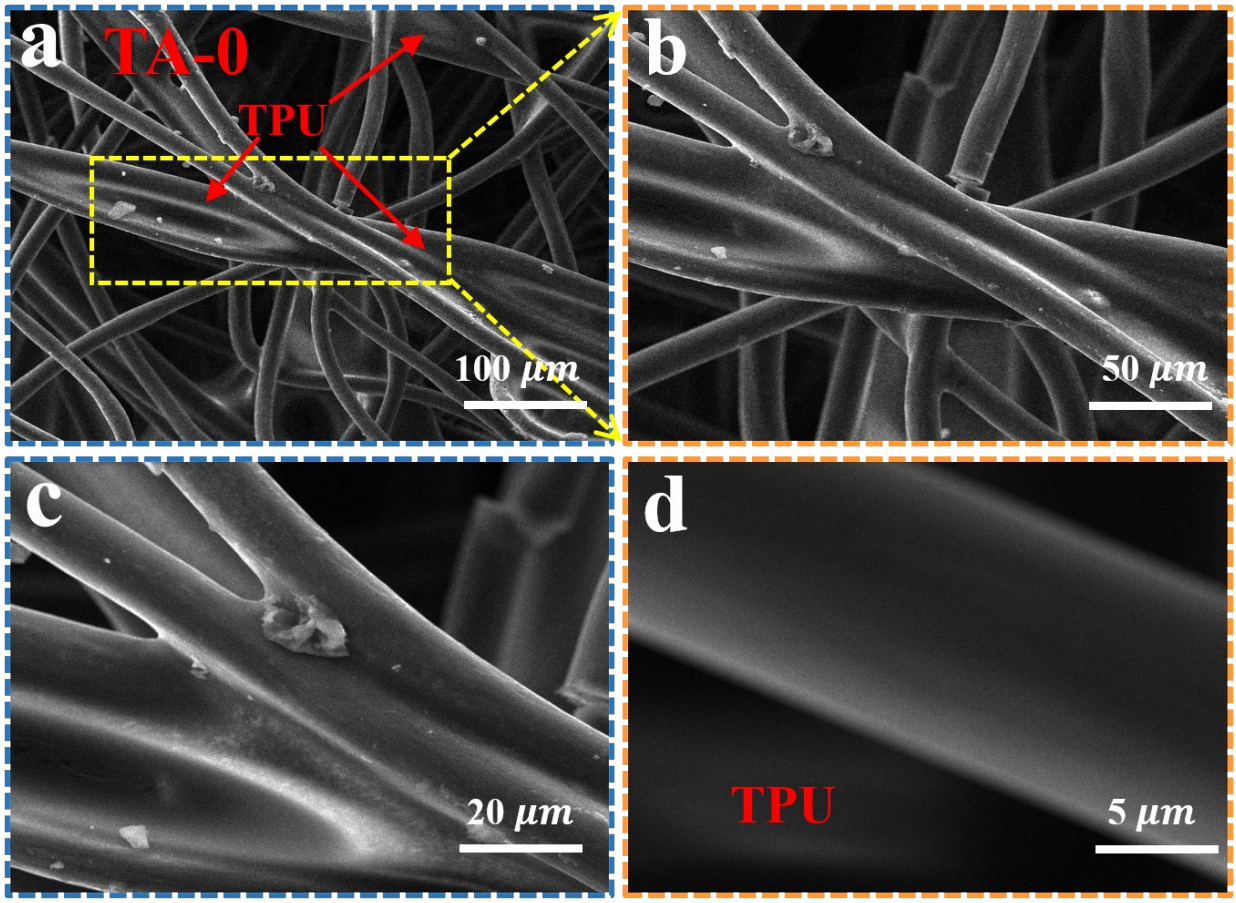

Fig. S2. The SEM of CFF covered by a thin TPU layer.

3. The power coefficients the TPU-coated AgNWs@CFF

To describe the shielding mechanism of the prepared TA-*x*, the power coefficients (R, A and T) calculated from the collected S parameter (S_{11} and S_{21}) under various dipping-drying cycles are

shown in Fig. S3. Apparently, R, much higher than A, increases gradually with the increase of dipping-drying cycles. This is mainly ascribed to the impedance mismatch between the free space and TA-*x* owing to its superior electrical conductivity. It is noted that R and A are quantitative characteristics of power balance, while EMI SE is a relative quantity and is unrelated to the absolute power coefficients.

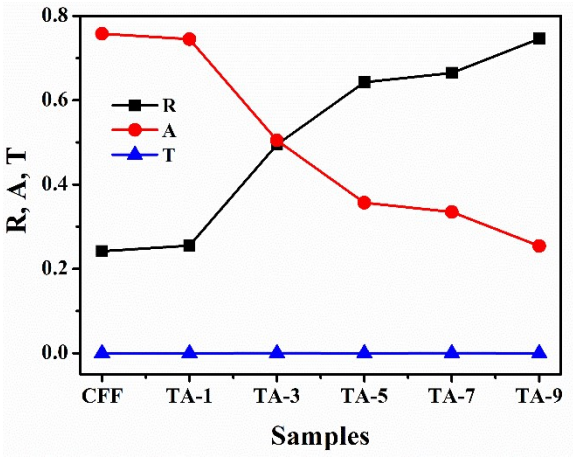

Fig. S3. The power coefficients at the frequency of 10.3 GHz for the CFF as well as TA-*x*.

4. SE_R/SE_T and SE_A/SE_T of the CFF and TA-*x*

As a result of the porous structure, the entered EMW are trapped in the foam and endlessly attenuated among the cell walls, being not able to escape from the limited space until they are absorbed. Fig. S4 presents the ratio of SE_R or SE_A to SE_T of the prepared samples, revealing much higher SE_A/SE_T than SE_R/SE_T.

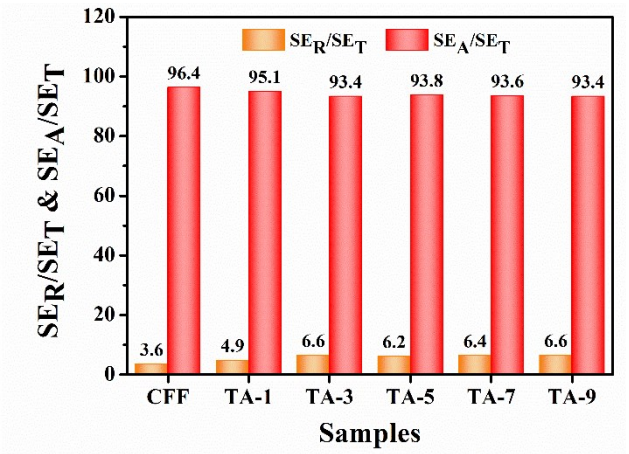

Fig. S4. SE_R/SE_T and SE_A/SE_T of the pure CFF and prepared TA-*x*.

5. The calculations for the theoretical EMI SE of the TPU-coated AgNWs@CFF

The theoretical EMI shielding performance of the TPU-coated AgNWs@CFF was calculated based on the following equations [26,27].

$$SE_R = 39.5 + 10log\frac{\sigma}{2\pi f\mu} \quad (1)$$

$$SE_A = 8.7d\sqrt{\pi f\mu\sigma} \quad (2)$$

Where σ is the electrical conductivity of materials and d is the thickness of sample.

6. The current variations of TA-*x* for multicycle compression

The structural stability and durability of the prepared TA-*x* could be further confirmed by evaluating the current variation upon cyclic compressions (Fig. S5). The current output is nearly invariable, and the waveform of current curve after 1200 cycles is almost the same as its initial response, revealing the excellent structural stability and durability of the prepared TA-*x*.

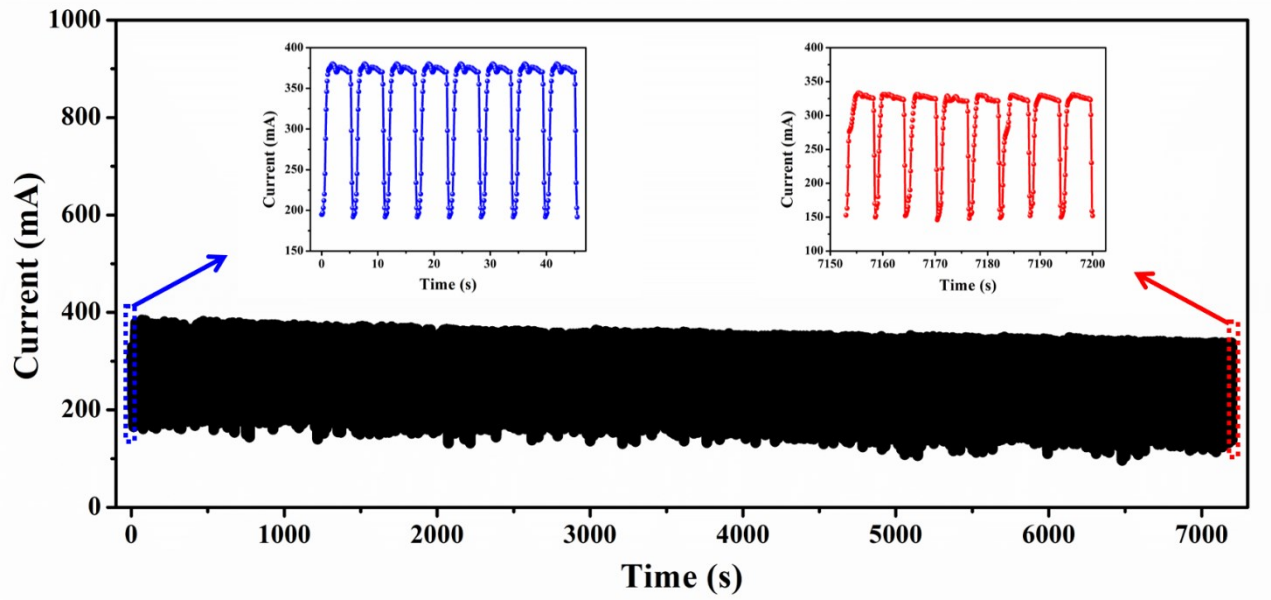

Fig. S5. Current variations of TA-*x* for 1200 cycles of loading-unloading at 9% of strain.

7. The current response of various joints bending

Finger bending response.mp4

Video. S1. Finger bending response.

Elbow bending response.mp4

Video S2. Elbow bending response.

Tiptoe stepping response.mp4

Video. S3. Tiptoe stepping response.

Heel stepping response.mp4

Video. S4. Heel stepping response.