The imidization of PAA was presented in the FTIR spectra in Fig.S1, the PAA materials were confirmed by the characteristic peaks at 1720, 1660, 1560 cm^{-1} and 2940 cm^{-1} for the C=O (acid), C=O (amide), C-N (amide) and H-N (amide) stretching vibration, respectively. PAA was then transformed to PI via thermal imidization, as shown by the characteristic absorption double peaks at 1781 and 1720 cm^{-1} for both the symmetric and asymmetric C=O stretching vibrations of the imide group and the peak shift at the 1376 cm^{-1} and 725 cm^{-1} C-N-C stretching vibration for PI

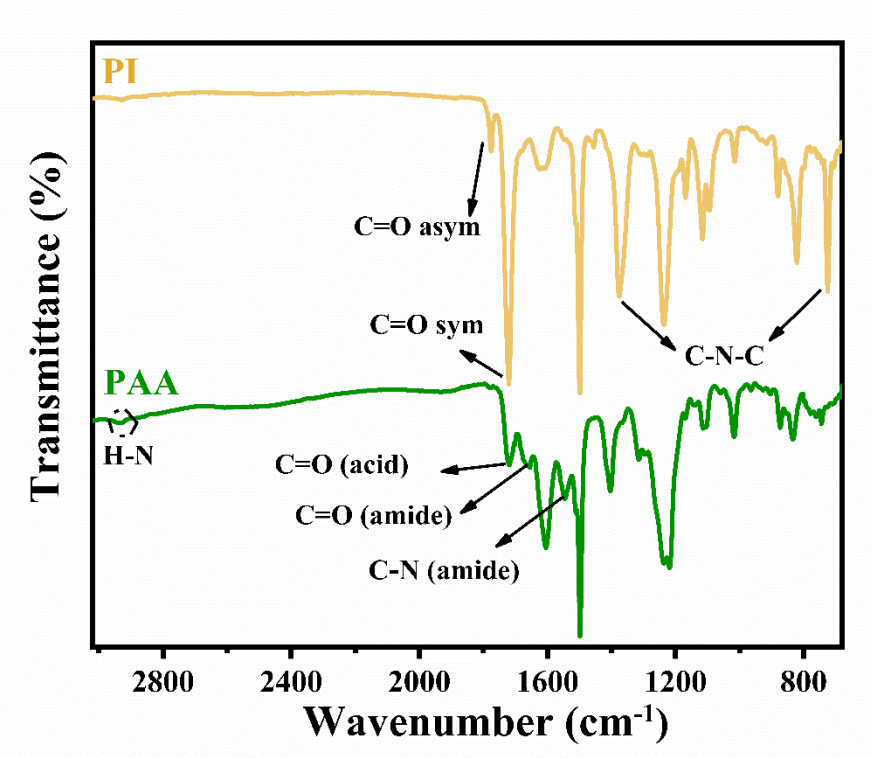

Fig. S1. FTIR spectra of thermal imidization of PAA

The EWW attenuation performance of PPC-700 and PPC-800 was shown in Fig. S2 a, b. As PPC-700 and PPC-800 only has dielectric loss component, it fails to get a fine EM matching condition and obtain a strong EMW attenuation ability. At a filler loading of 30 wt%, the minimum RLs of PPC-700 are smaller than -2.3 dB and he minimum RLs of PPC-800 are -1.3 dB.

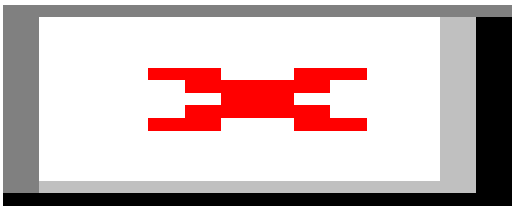

Fig. S2. (a) Reflection loss (RL)-frequency curves of PPC-700 in the range of 2–18 GHz with absorber thicknesses from 1.8 to 5.5 mm and an absorber content of 30%.
(b) Reflection loss (RL)-frequency curves of PPC -800 in the range of 2–18 GHz with absorber thicknesses from 1.8 to 5.8 mm and an absorber content of 30%.

As shown at Fig.S3, the weak dispersion peaks of PIC-800 at 43.7° correspond to (100) crystal planes of graphite, implies a slight increase in the degree of carbonization of PPC at 800 °C. But PPC-800's ID/IG Still similar to PPC-700. Besides, the pore size of PPC-800 is also similar to PPC-700 Complex permittivity of PPC-800 maintain a lower value due to its lower degree of carbonization.

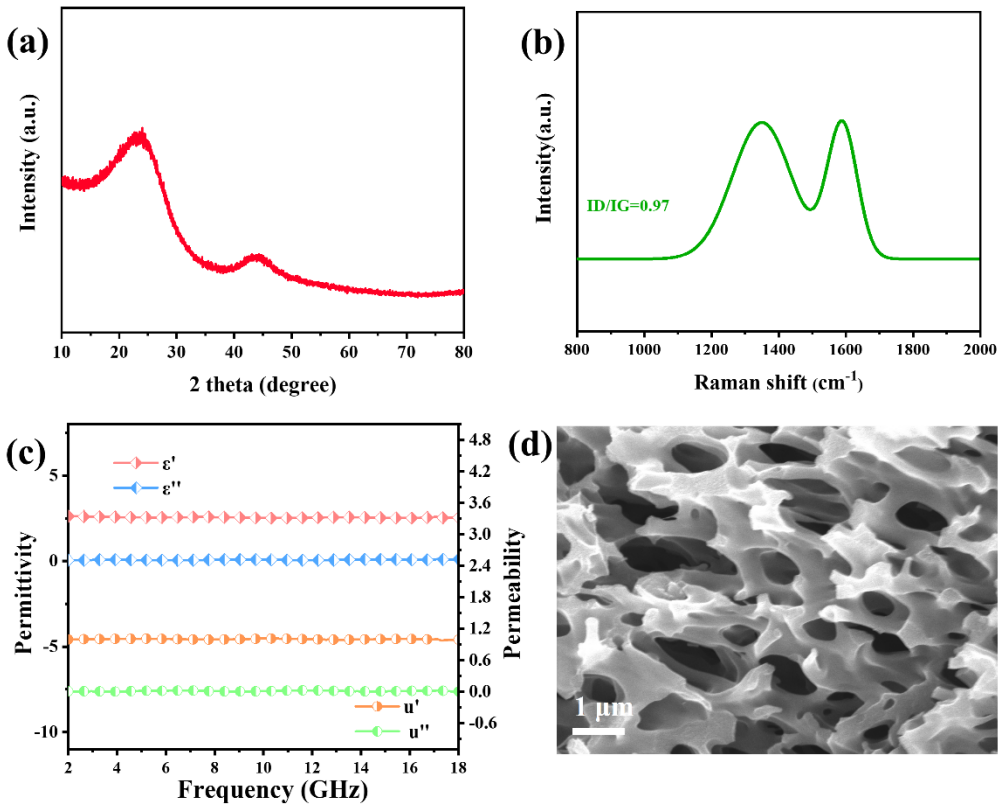

Fig. S3. (a)XRD pattern, (b)Raman spectrum, (c)complex permittivity and complex permeability, (d)SEM image of PPC-800.

As shown at Fig. S4, the PPC-700 Has a multi-level pore structure. The pore size distribution near 1 μm matches the SEM part in the manuscript, which may be due to the damage of mercury to the pore structure under pressure. Pores distributed at 100 microns can be observed on the surface of the membrane, possibly due to rapid phase separation, shown at Fig. S5.

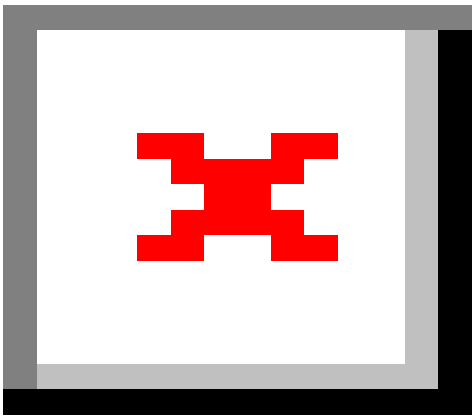

Fig. S4. Pore size distribution plots for PPC-700.

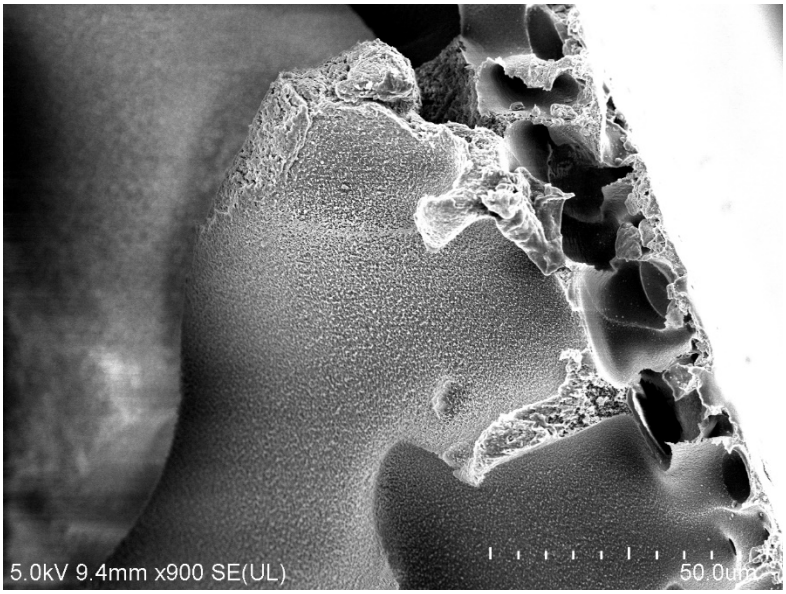

Fig. S5. SEM image of PPC-700 membrane's cross section.