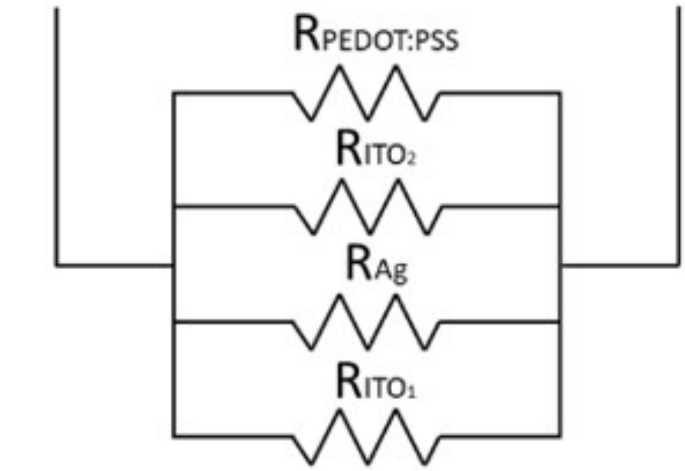
Supplemental Materials



$$\frac{1}{R_{to}} = \frac{1}{R_{ITO_1}} + \frac{1}{R_{Ag}} + \frac{1}{R_{ITO_2}} + \frac{1}{R_{PEDOT:PSS}}$$

Fig. S1 Equivalent circuit of the PEDOT:PSS-ITO-Ag-ITO assembly for the overall conductance calculation. Each layer of the thin film acts as a resistor and then is connected in parallel to form the total resistance. The measured sheet resistance of 20 nm ITO, 9.45 nm Ag, 24 nm ITO and 30.5 nm PEDOT:PSS was 305.2 Ω/sq, 10.28 Ω/sq, 254.2 Ω/sq, and >1000 Ω/sq (beyond the range of four-point probe), respectively.

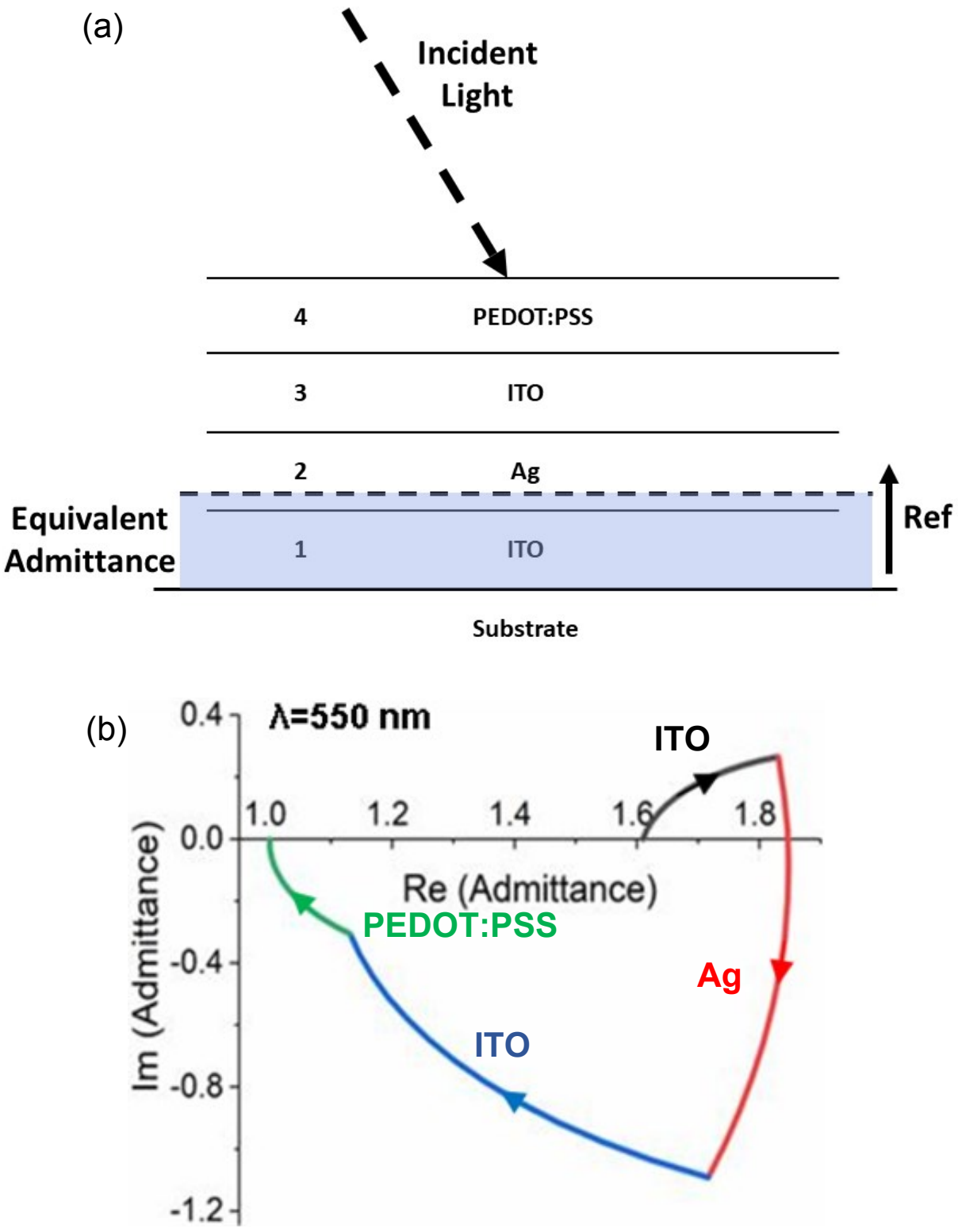


Fig. S2. **a** Equivalent admittance (blue shade) of the multilayer PEDOT:PSS-ITO-Ag-ITO thin film coatings. Treating as a virtual reference plane from the substrate. **b** Admittance loci with an example of PEDOT:PSS (30.5 nm)-ITO (24 nm)-Ag (9.45 nm)-ITO (20 nm) assembly for achieving the highest transmittance at the preferred 550 nm wavelength.

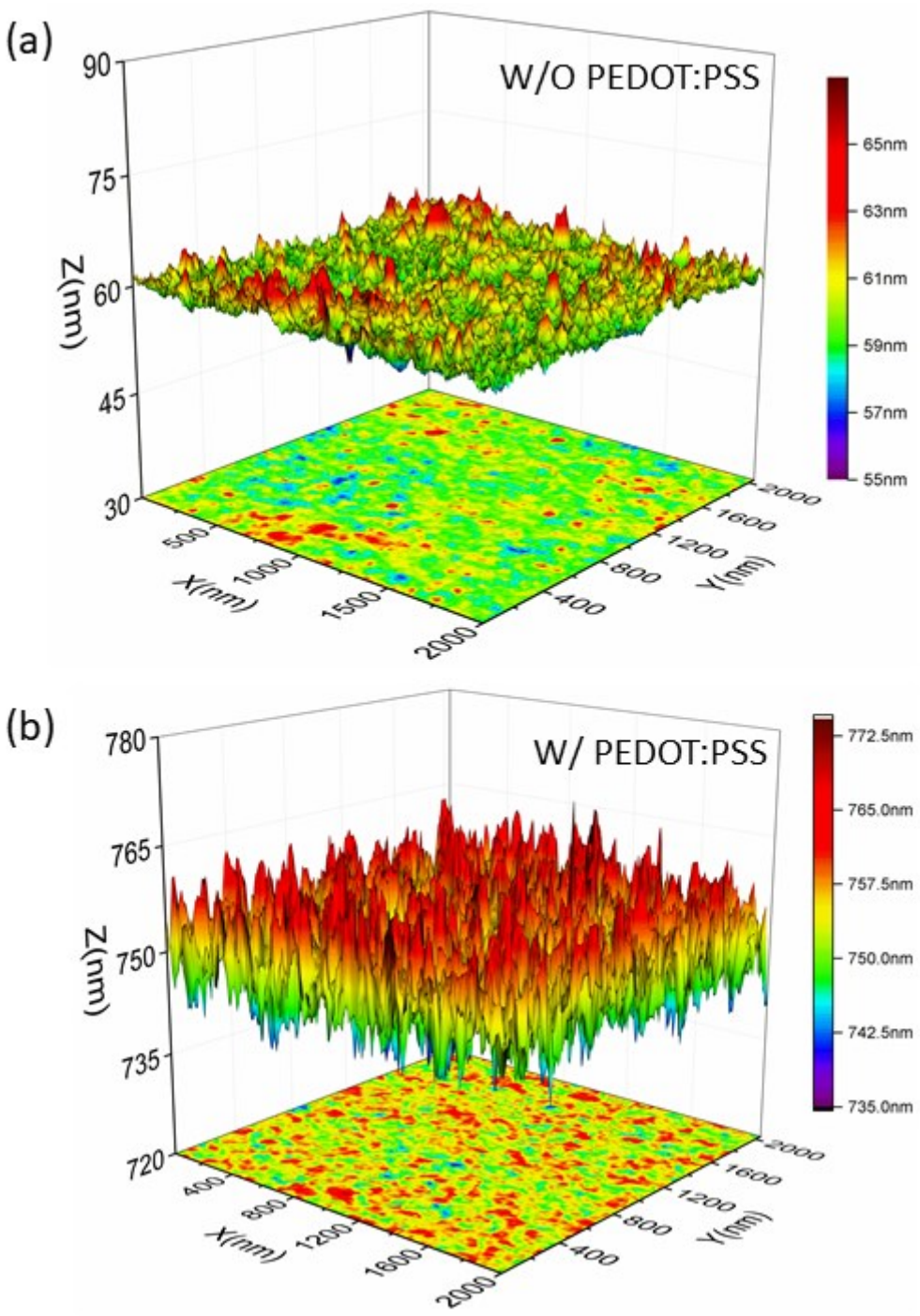


Fig. S3. Surface roughness changes **a** before and **b** after spin-coating PEDOT:PSS layer by Atomic force microscopy (AFM). The average roughness (R_a) and peak-to-peak mean roughness depth (R_t) without the PEDOT:PSS film is 0.85 nm and 12.02 nm, while R_a and R_t. with the PEDOT:PSS film is 3.33 nm and 39.15 nm.

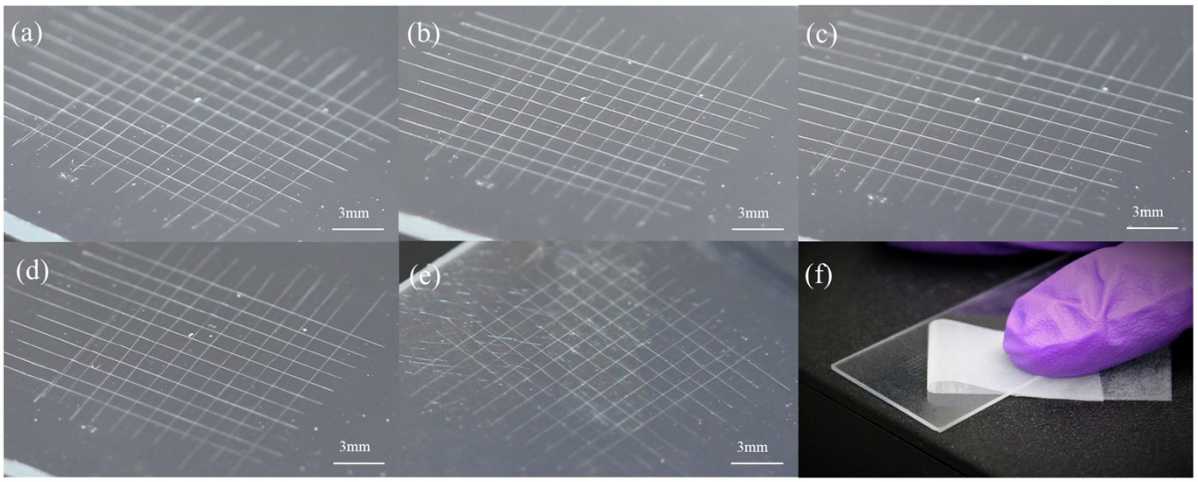


Fig. S4. Peel-off test photos of 100 1×1 mm^2 blade-scratched squares with **a** no peel-off, **b** one peel-off test, **c** 10 peel-off tests **d** 50 peel-off tests **e** Parylene C delamination after 50-time peel-off tests **f** the peeling-off method.

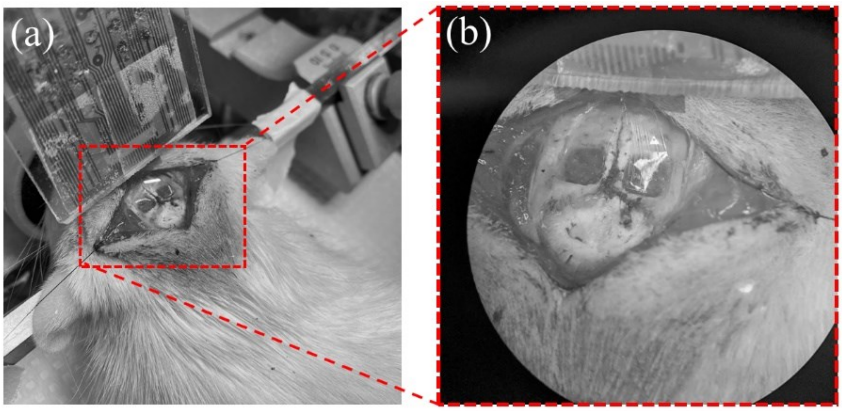


Fig. S5. **a** Image of a transparent μECoG array placed on the brain tissue of the rat during the in vivo animal experiments. **b** Zoom-in microscope image shows the exposed brain tissue with the array attached.

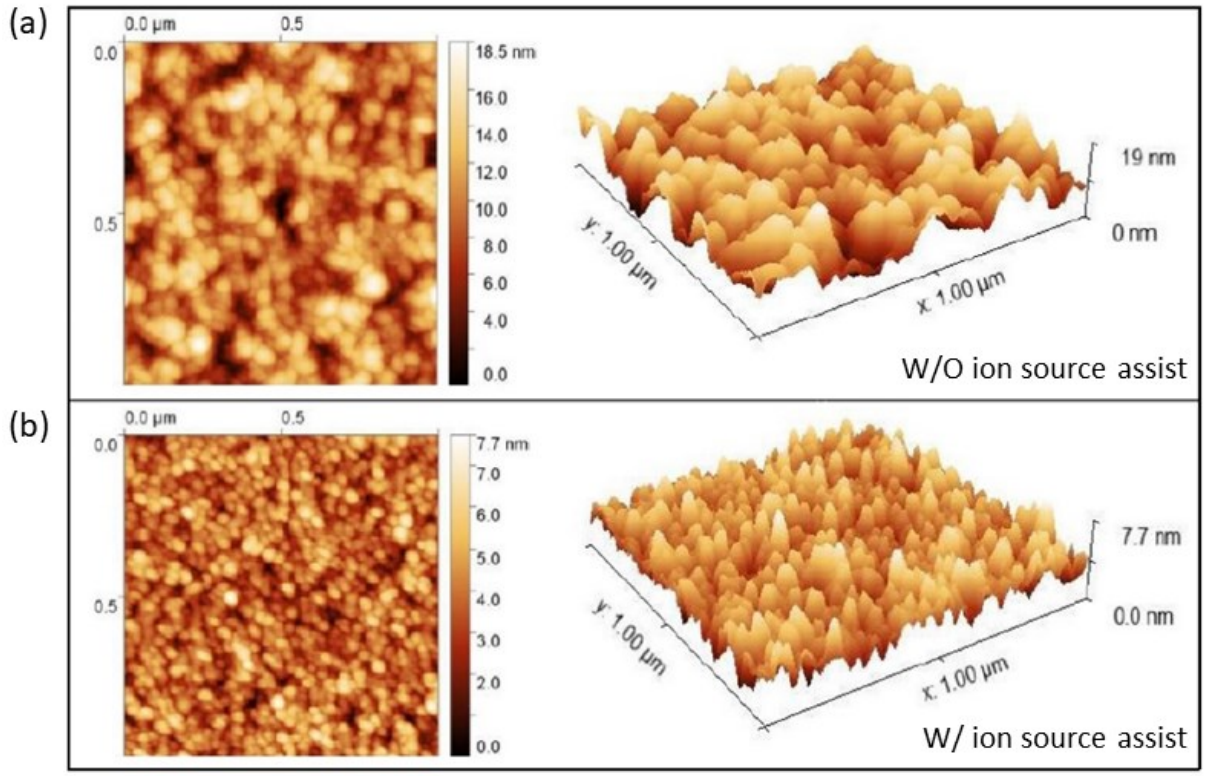


Fig. S6. Surface morphology of sputtered ITO **a** without and **b** with ion source assist, measured by atomic force microscopy (AFM). The ion source assisted ITO sputtering enables smoother and denser ITO thin films.

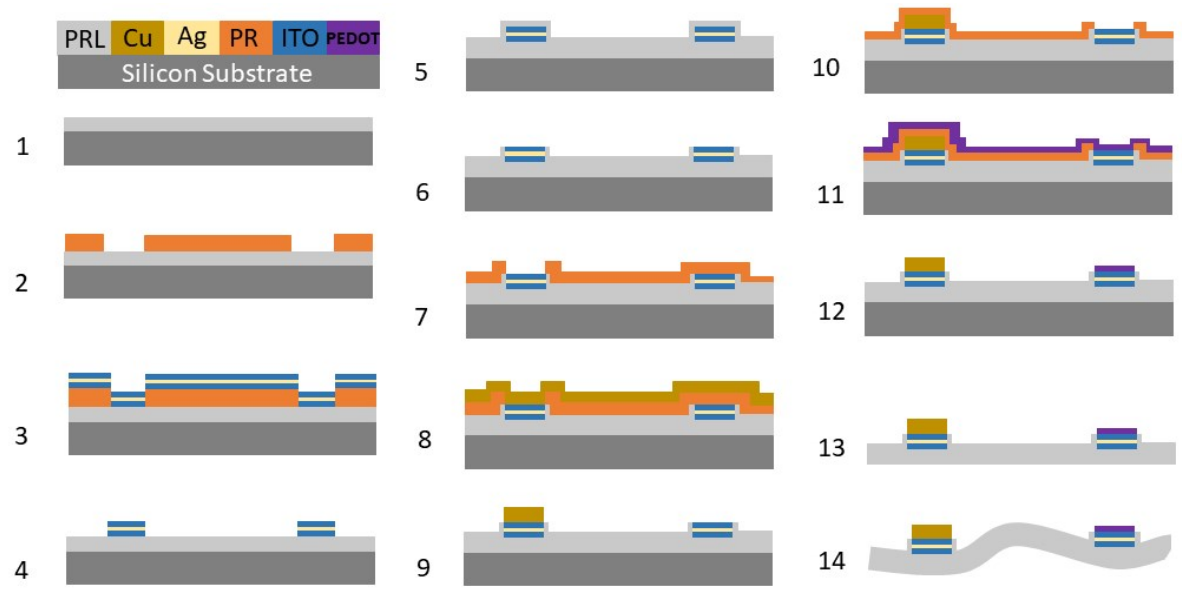


Fig. S7 μECoG array fabrication steps: **1** Deposit Parylene C. **2** Pattern the photoresist. **3** Deposit ITO-Ag-ITO thin films. **4** Wash off photoresist and pattern the ITO-Ag-ITO layer. **5** Deposit the second Parylene C layer. **6** Etch Parylene C selectively to exposure the electrode sits and contacts. **7** Pattern another layer of photoresist. **8** Deposit Cu. **9** Wash off photoresist and pattern Cu over the contact areas. **10** Pattern another layer of photoresist. **11** Deposit PEDOT:PSS. **12** Washing off photoresist to obtain the PEDOT:PSS patterns on the electrode sites. **13** Release the μECoG array from silicon substrate. **14** Flexibility of the released μECoG array.