Supplementary Information

In vitro recording and stimulation performance of multi-electrode arrays passivated with plasma-enhanced atomic layer-deposited metal oxides

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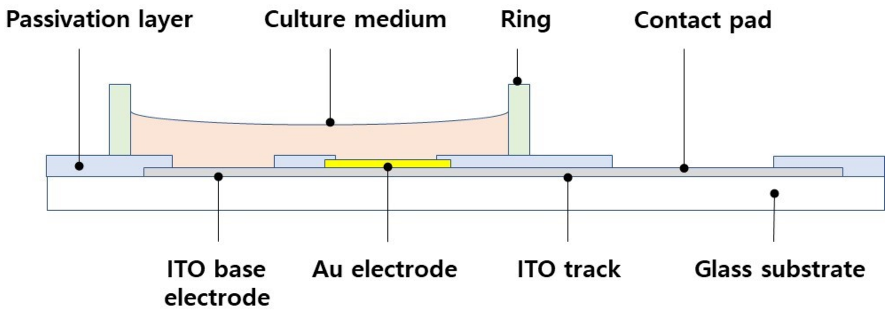
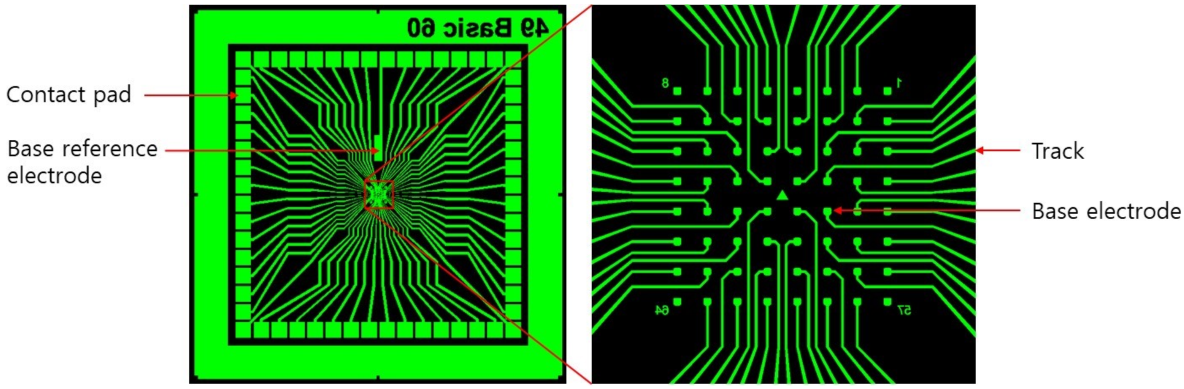
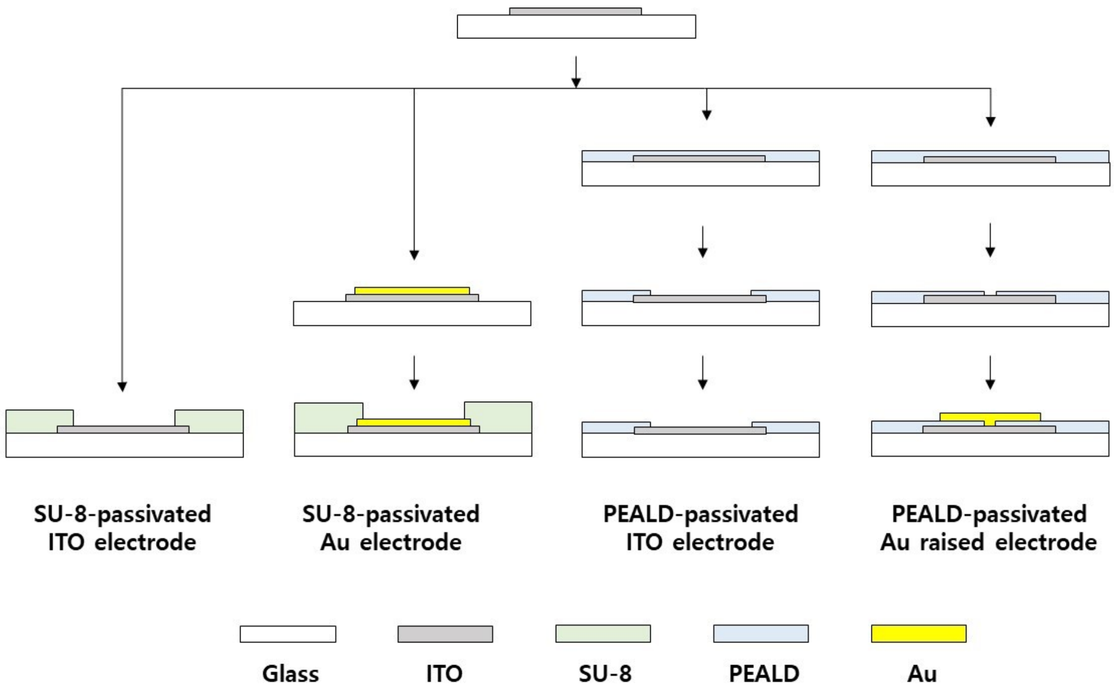


(a)

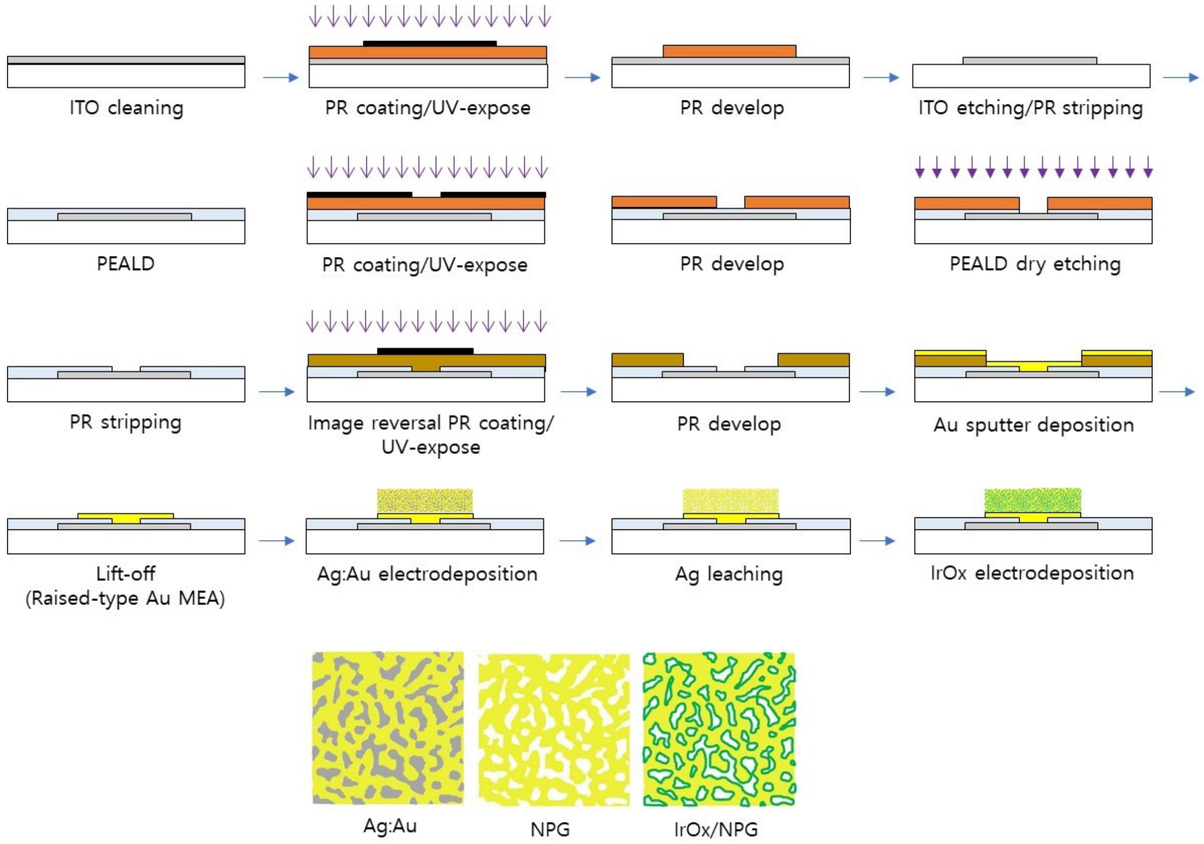


(b)

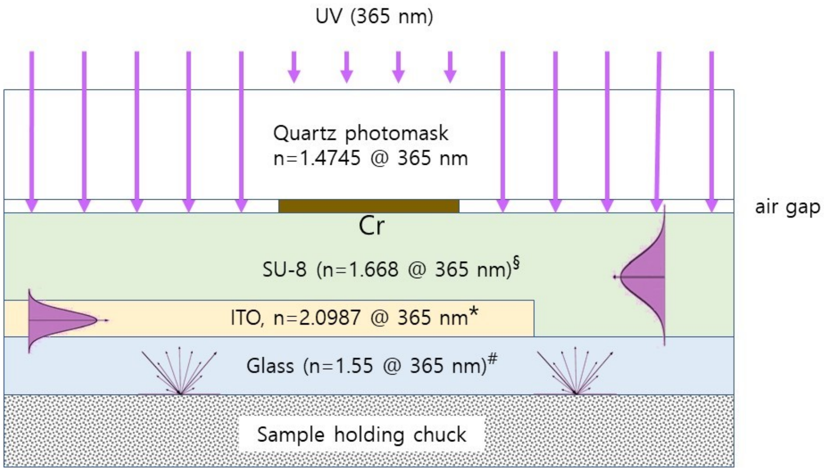
Supplementary Fig. S1 (a) Cross-sectional schematic of a conventional multi-electrode array (MEA), along with the definitions of the terms used in this study. (b) Design layout of the indium–tin oxide (ITO) layer. ITO comprises tracks, base electrodes, base reference electrode, and contact pads. The pads are designed to fit a multichannel recording system (MEA2100-Systems, Multichannel Systems). The centre-to-centre distance between the adjacent base electrodes is 200 μm.



Supplementary Fig. S2 Simplified fabrication diagrams of different types of fabricated MEAs. Surface modification of the electrodes is performed only on the Au electrodes.



Supplementary Fig. S3 Schematic of the fabrication of PEALD-passivated raised-type Au MEA and its electrode modifications via electrodeposition. The structures of electrodeposited Ag:Au alloy, Ag-leached nanoporous Au (NPG), and IrOx-electrodeposited NPG are schematically illustrated at the bottom.

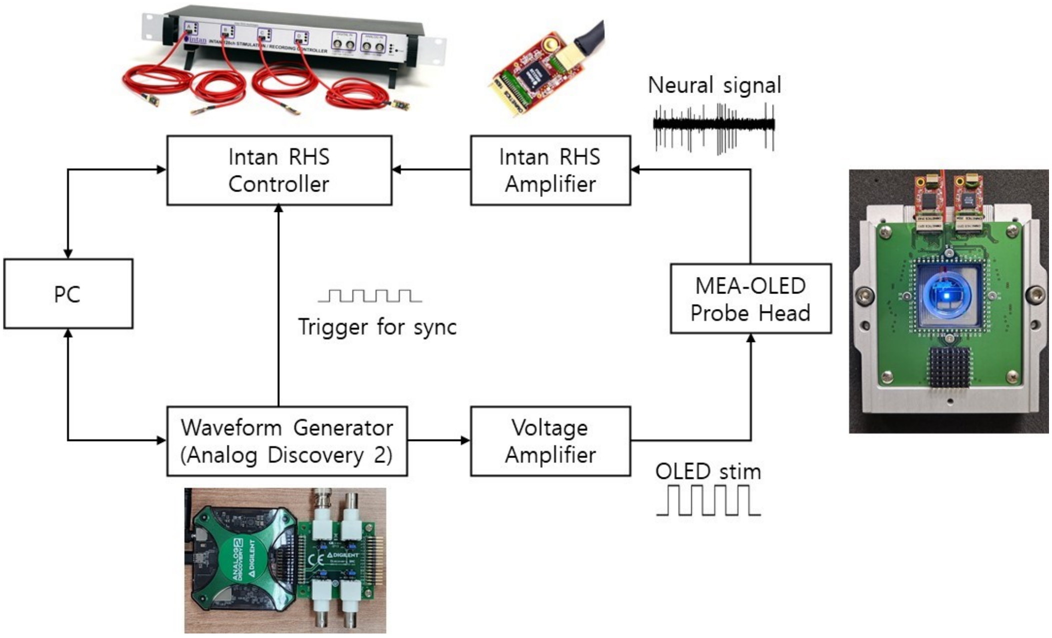


* https://refractiveindex.info/?shelf=other&book=In2O3-SnO2&page=Konig

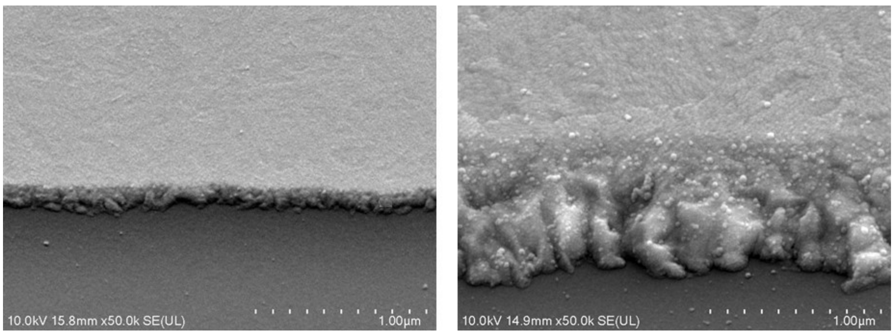
Glass. n=1.55 @ 365 nm, 1.52 @ 587.6 nm (provided by AMG, Korea)

§ SU-8. A. del Campo, C. Greiner, *J. Micromech. Microeng.*, 2007, **17**, R81–R95.

Supplementary Fig. S4 Schematic of the photopassivation of the ITO track with SU-8. Backside diffuse reflections collected from the ITO layer, resulting in photo-crosslinking of SU-8 on the ITO electrode. The photo-crosslinked SU-8 on the ITO electrode remains intact after the development process. Therefore, it is important to reduce backside reflections.



Supplementary Fig. S5 OLED driving and MEA recording setup for in vitro optogenetics and neural signal recording.



Supplementary Fig. S6 FESEM images of wet-etched 50-nm-thick ITO (left) and 300-nm-thick ITO (right).

Supplementary Note

Local field potentials (LFPs) represent the summed electrical activity of a population of neurons in the nervous system. Compared with spikes from individual neurons, LFPs are characterized by higher signal amplitudes (approximately 1 mV) and low frequency components (10–300 Hz), whereas spikes typically exhibit signal amplitudes in the range 100–300 μV and high frequency components (>1 kHz). An evoked LFP (eLFP) is an electrical signal that reflects neuronal activity in response to a stimulus. LFPs are believed to arise from the summation of synaptic potential fluctuations across thousands of neurons surrounding the electrode (Nat. Rev. Neurosci. 2012, 13, 407–420). Changes in the amplitude or maximum slope of the eLFP are interpreted as indications of the potentiation or depression of the synaptic strength. eLFPs are used to evaluate the stimulation performance of an electrode.