ADVANCED MATERIALS

Supporting Information

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Self-Powered Programming of Fibroblasts into Neurons via a Scalable Magnetoelastic Generator Array

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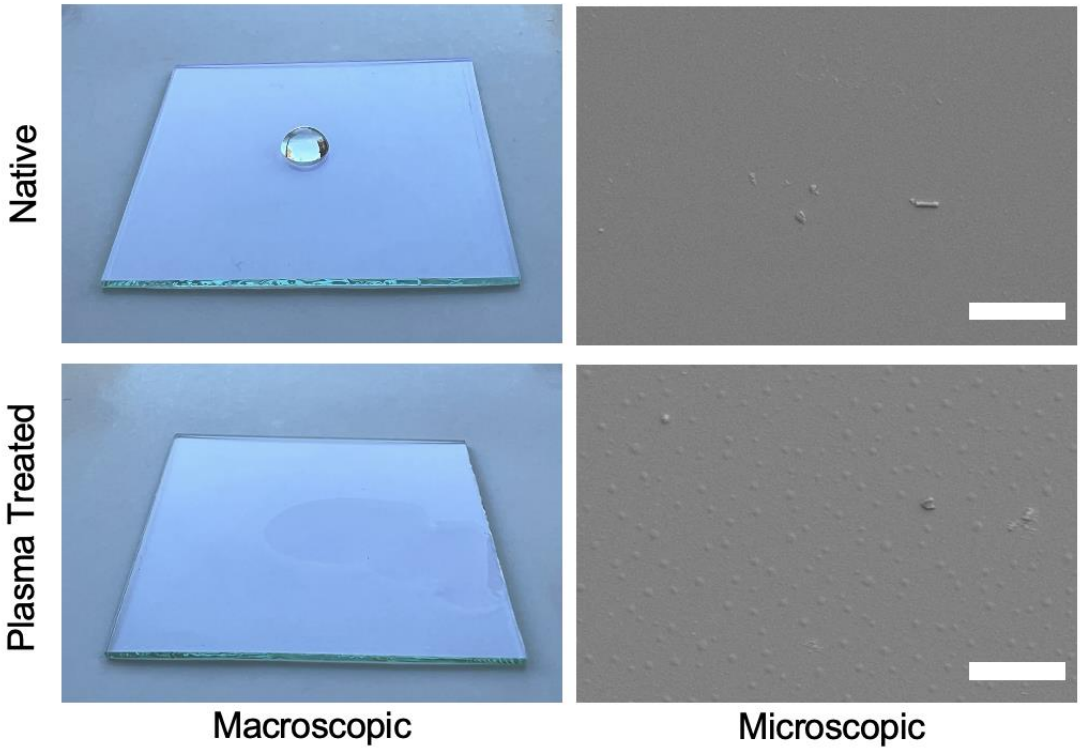

Figure S1: Indium tin oxide (ITO) glass functionalization to enhance cell adhesion. Macroscopic and microscopic views of ITO glass pre- and post- a 5-minute plasma treatment protocol. Hydrophobicity loss of the ITO glass is demonstrated by the change of surface dispersion of a drop of water at the macro level, and by the formation of a functionalized surface at the microscopic level (SEM microscopy). Scale bar = 10 µm. SEM = Scanning electron microscopy. SEM photos taken using a Zeiss, supra 40VP microscope.

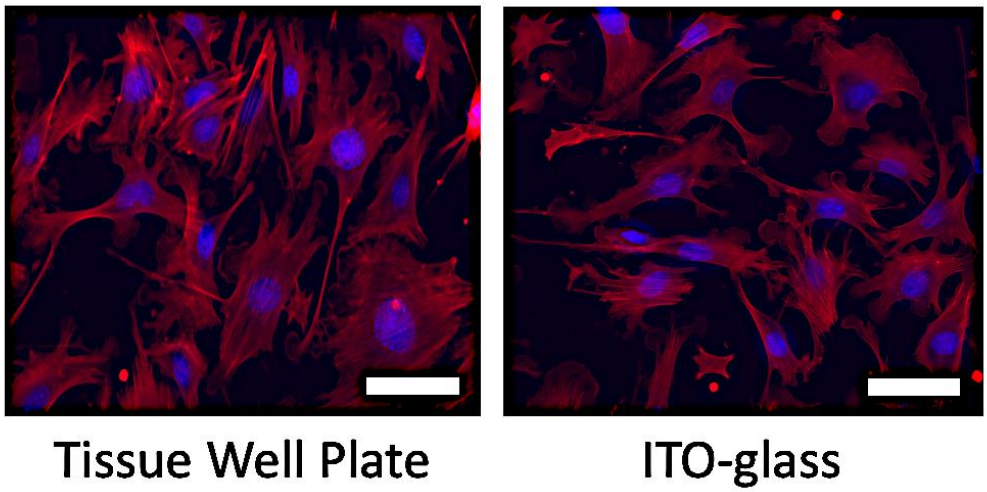

Figure S2: Fibroblast adhesion. Fibroblast adhesion on standard tissue-well plates vs plasma-treated ITO glass. Phalloidin-staining of actin filaments (red) and 4′,6-diamidino-2-phenylindole (DAPI, blue) staining of nucleus showed no observable difference. Scale bars = 50 µm.

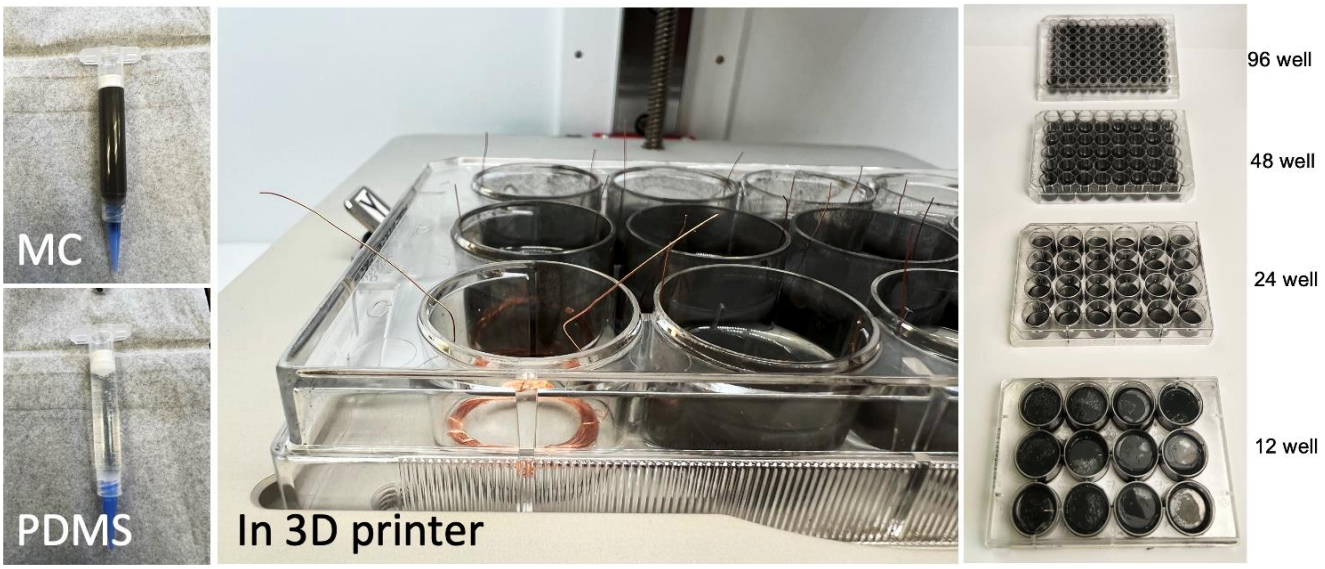

Figure S3: Three-dimensional (3D) printing of the magnetoelastic generator (MEG) electrical stimulation platform. Simple magnetomechanical coupling (MC) and polydimethylsiloxane (PDMS) inks (left panels) were deposited by using a commercially available extrusion-based 3D bioprinter (middle panel). The right panel shows 3D printed MEG electrical stimulation platforms in configurations ranging from 12-well up to 96-well tissue culture plates.

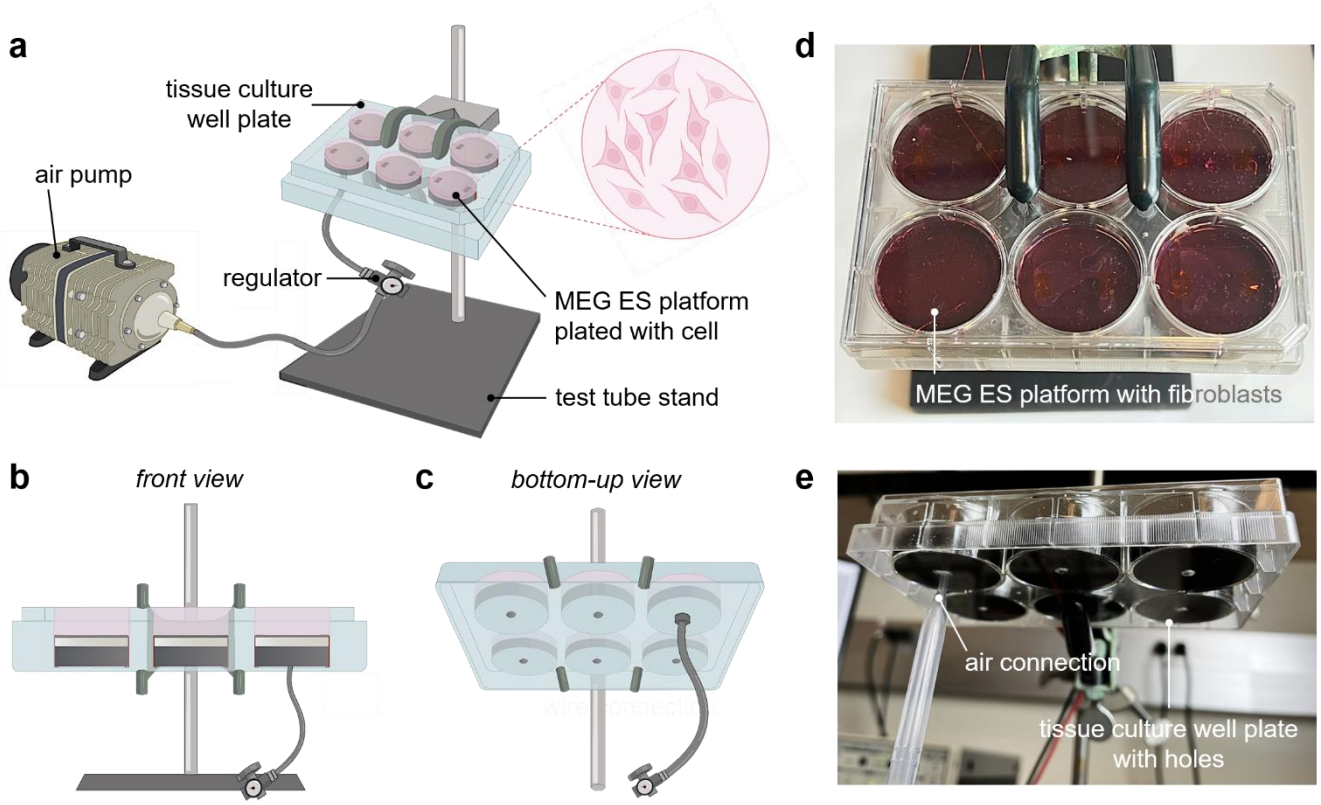

Figure S4: Setup of the magnetoelastic generator (MEG) electrical stimulation platform. (**a-c**) Schematic of the experimental setup for the MEG platform, which include both front (**b**) and bottom-up (**c**) views of the setup. The pneumatic actuation was applied by removing cell culture plates from the incubator and exposing them to an air pressure gauge (PSL15-160, PneumaticPlus), which was connected to a compressed air outlet (UCLA Bioengineering laboratory house line) with openings for 100, 200, 300 and 400 kPa outputs were devised for pulsed release. (**d-e**) Images of the actual setup which show the tissue culture well plate containing the MEG platform with cultured fibroblasts (**d**) and the air connection to the base of the tissue culture well plate (**e**).

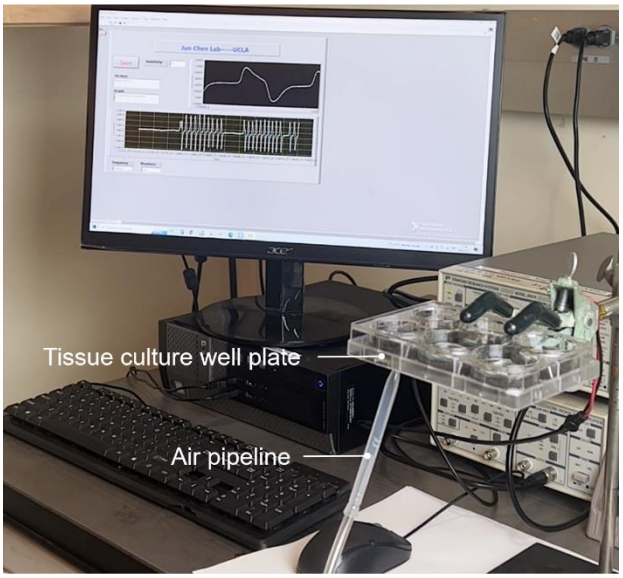

Figure S5: Computer and electronic setup of the magnetoelastic generator (MEG) electrical stimulation platform. Images of the actual computer and electronic setup show the wires connected to the tissue culture well for electrical signals measurement, the air pipeline connected to the base of the tissue culture well plate for air pressure actuation, and the LabView program for real-time electrical signals display.

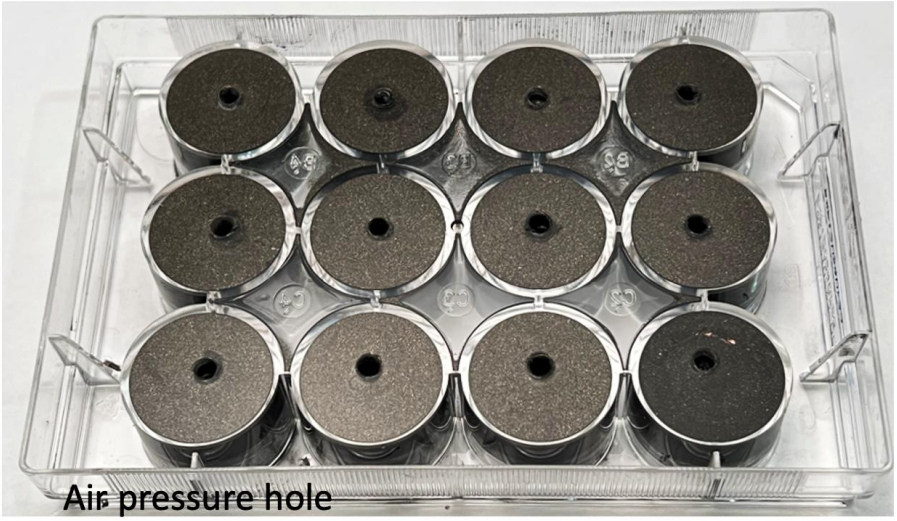

Figure S6: Perforation of the magnetoelastic generator (MEG) electrical stimulation platform. Clear perforation on the bottom side of a 12-well tissue culture plate onto which the MEG electrical stimulation platform was fabricated. Air pressure holes allow for simple air pressure actuation and thus MEG electrical stimulation.

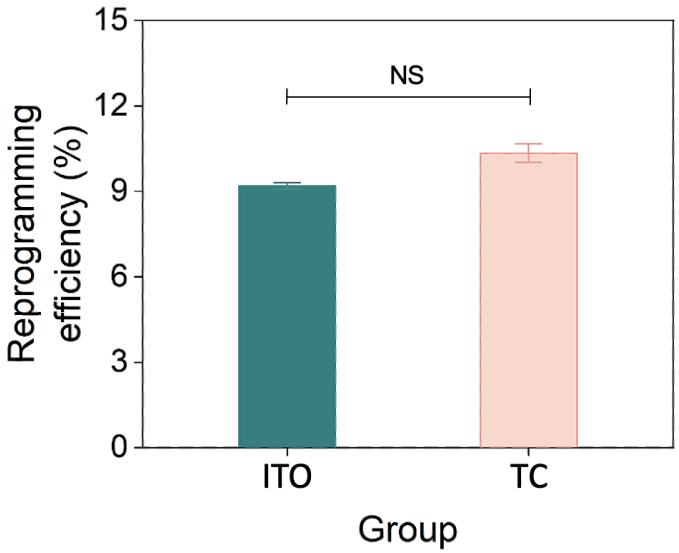

Figure S7: ITO glass surface does not affect fibroblast reprogramming into induced neurons. Reprogramming efficiency of fibroblasts directed to neuronal phenotypes obtained using ITO glass surface vs tissue culture well (based on the number of Tubulin Beta 3 Class III+ (Tubb3+) cells identified on day 10 relative to the number of fibroblast cells initially seeded), Bar graph shows mean ± SD (*n*=3), NS = not significant. Significance was determined by two-tailed, unpaired t test.

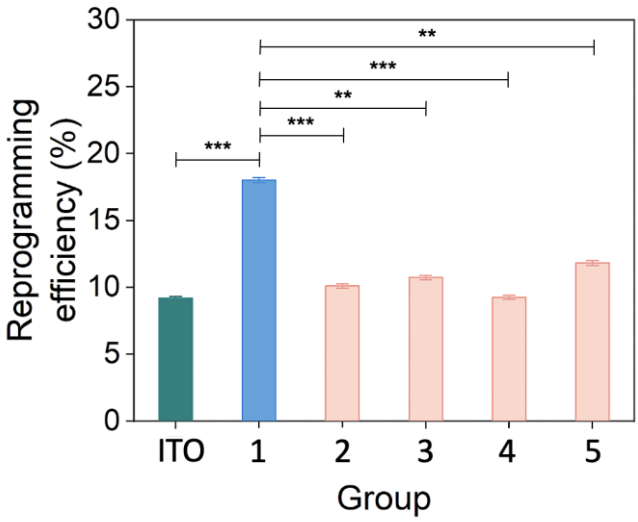

Figure S8: A fully functional MEG ES platform is necessary to enhance fibroblast reprogramming into induced neurons. Reprogramming efficiency of fibroblasts directed to neuronal phenotypes obtained using: (ITO) ITO glass surface alone, (1) a fully function MEG ES platform, (2) an MEG ES platform with ITO glass replaced by normal (non-conductive) glass, (3) an MEG ES platform with disconnected Cu wires, (4) an MEG ES platform without an MI layer, and (5) an MEG ES platform without an MC layer. Reprogramming efficiency based on the number of Tubulin Beta 3 Class III+ (Tubb3+) cells identified on day 10 relative to the number of fibroblast cells initially seeded, Bar graph shows mean ± SD (n=3), **p ≤ 0.01, ***p ≤0.001, NS = not significant. Significance was determined using a one-way ANOVA and Tukey's multiple comparison test.

Table S1: Maximum air pressure tolerance. Varying air pressure limits for different MEG electrical stimulation substrate configurations.

Tissue culture plate type	MI (coil turns)	MC thickness (mm)	PDMS thickness (mm)	ITO-glass thickness (mm)	Aperture for air pressure (mm)	Pressure Max (kPa)
6-well plate	150	6	15	1.1	3	**800**
12-well plate	75	5	15	1.1	3	**650**
24-well plate	35	4	15	1.1	25	**320**
48-well plate	20	3	15	1.1	15	**250**
96-well plate	10	2.5	15	1.1	15	**200**