Electronic Supplementary Material (ESI) for Lab on a Chip.

Constant-potential environment for activating and synchronizing cardiomyocytes colonies with on-chip ion-depleting perm-selective membranes†

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1. Schematics of action potential and contraction-relaxation kinetics

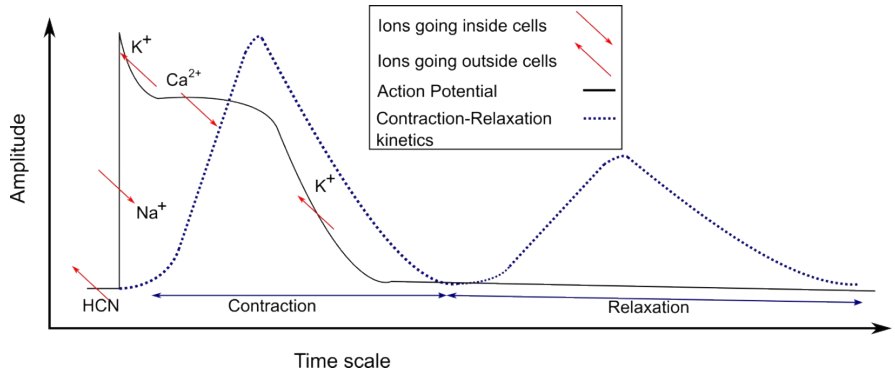

Figure S1: Schematic diagram depicting the rat cardiomyocytes (rCMs) action potential superimposed with its contraction relaxation kinetics. Based on ref [1].[2]

2. Control experiment of 'ON' and 'OFF' Voltage pulses with a 30s period without using CEM:

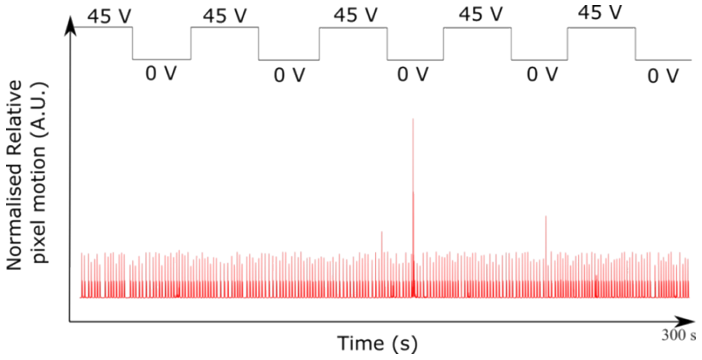

Figure S2: The trace obtained from image analysis of rat cardiomyocytes (rCMs) without using a CEM with the applied voltage when it is switched ON and OFF.

3. Microfluidics and device fabrication:

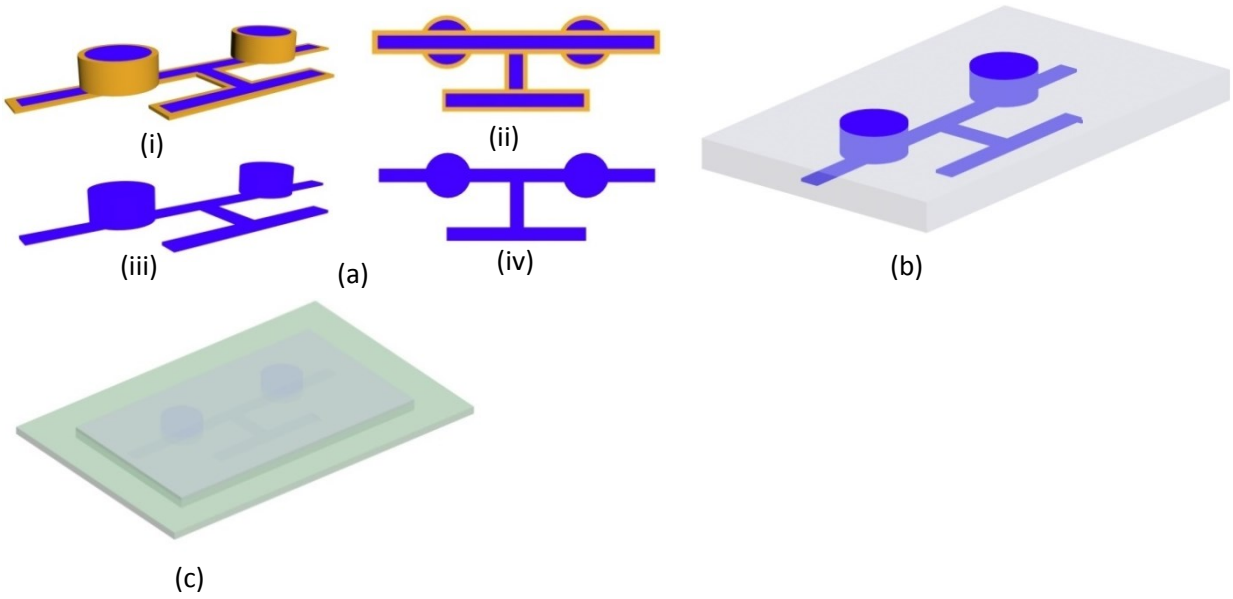

Figure S3: Fabrication steps of the experimental platform. (a) A shematics of 3D-printed wax mold showing the sacrificial layer in orange color (i) side-view, (ii) bottom-view and after removal of the layer by dissolving in BIOACT VSO (Vantage Specialty Chemicals) solvent for 2 days (iii) side-view,(iv) bottom view (b) PDMS is poured on the wax print (indicated in blue) in 10:1 ratio and cured at 65C for overnight (d) Plasma bonding of the PDMS chip on a microscopic glass slide after dissolving the wax print in DMSO.

4. Finite Element Simulation (FEM):

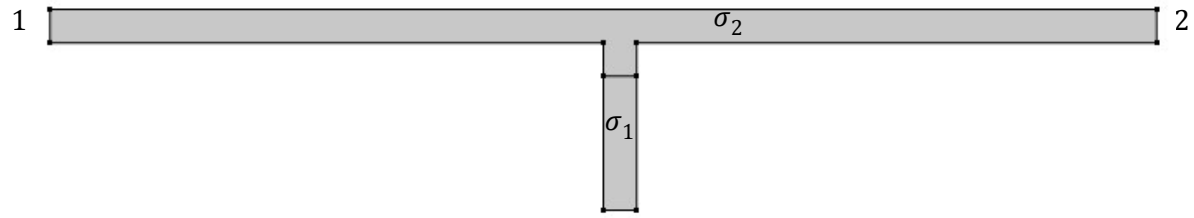

Figure S4: Schematics of computational domain and boundary conditions for leaky dielectric model of electrolytes

Leaky dielectric model of electrolytes ($\nabla^2 \sigma E = 0$) has been used to perform FEM simulations using Comsol Multiphysics 5.3a. Edge 1 represents ground and a finite potential is imposed on edge 2. Insulation boundary condition is imposed on all the other edges. The horizontal channel is modelled as deionised water with conductivity $3 * 10^{-4}\ S/m$ (σ_2)and the vertical channel has been modelled with conductivity $8 * 10^{-2}\ S/m$ (σ_2).

References:

1 B. J. van Meer, L. G. J. Tertoolen and C. L. Mummery, *Stem Cells*, 2016, **34**, 2008–2015.

2 T. Hayakawa, T. Kunihiro, T. Ando, S. Kobayashi, E. Matsui, H. Yada, Y. Kanda, J. Kurokawa and T. Furukawa, *J. Mol. Cell. Cardiol.*, 2014, **77**, 178–191.