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

Supplementary Figures

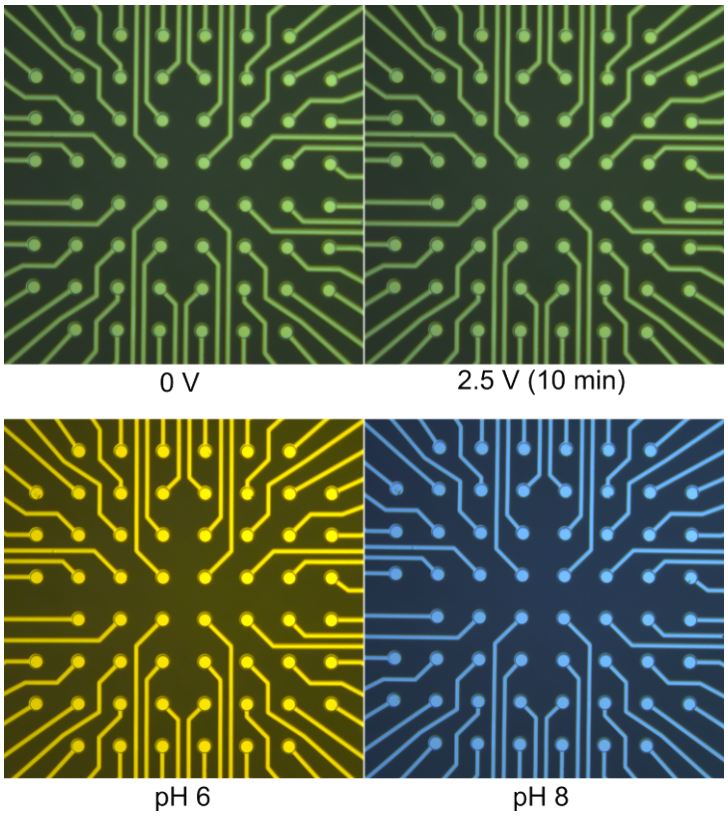

Fig. S1. pH of low-conductivity buffer as measured by a 0.1% bromothymol sulfone phthalein (BTB) solution. The pH of the low-conductivity buffer is in the 7.0-7.5 range and is unaffected by application of 2.5 V for 10 min. Images of BTB-containing calibration solutions at pH 6 and pH 8 are used to reference color.

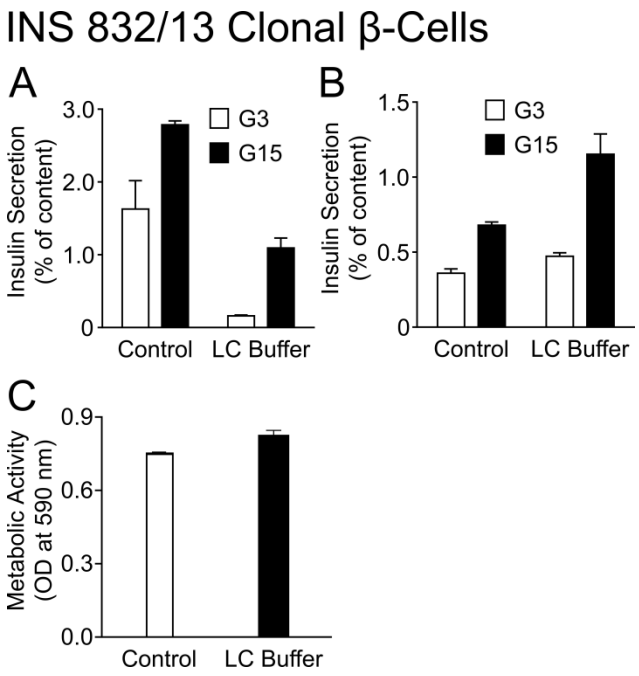

Fig. S2. Effects of custom low-conductivity buffer on clonal INS832/13 β-cells. Insulin secretion after short-term (30 min) (n=3) (A) and long-term (72 h) (n=4) (B) culture with control or low-conductivity buffer (LC Buffer) in response to 3 mM (white bars) and 15 mM (black bars) glucose. (C) Mitochondrial activity of cells after 24 h culture in control (white bar) (n=4) or LC buffer (black bar) (n=3) expressed in terms of optical density at 590 nm. Glucose concentration: 11 mM.

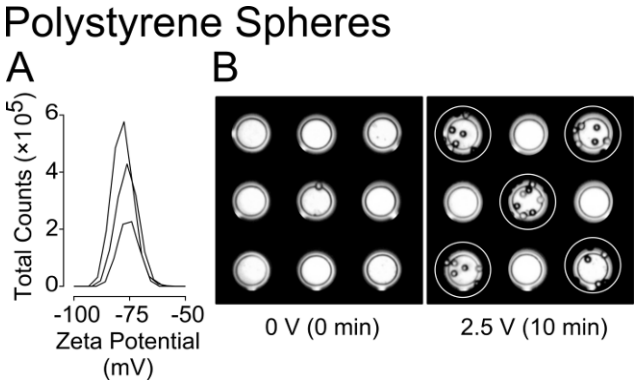

Fig. S3. Using polystyrene spheres to simulate cells for electrophoresis. (A) Distribution chart of apparent zeta potential of 10 μm polystyrene spheres showing total count of cells exhibiting a given zeta potential. Each curve corresponds to one sample of 1.0×10^6 cells/mL (n=3). (B) Migration of polystyrene spheres in micro-electrode array when exposed to a 1.5 V potential difference (positively charged electrodes indicated by white rings and negatively charged electrodes unmarked) for 10 min. Electrode diameter: 40 μm.

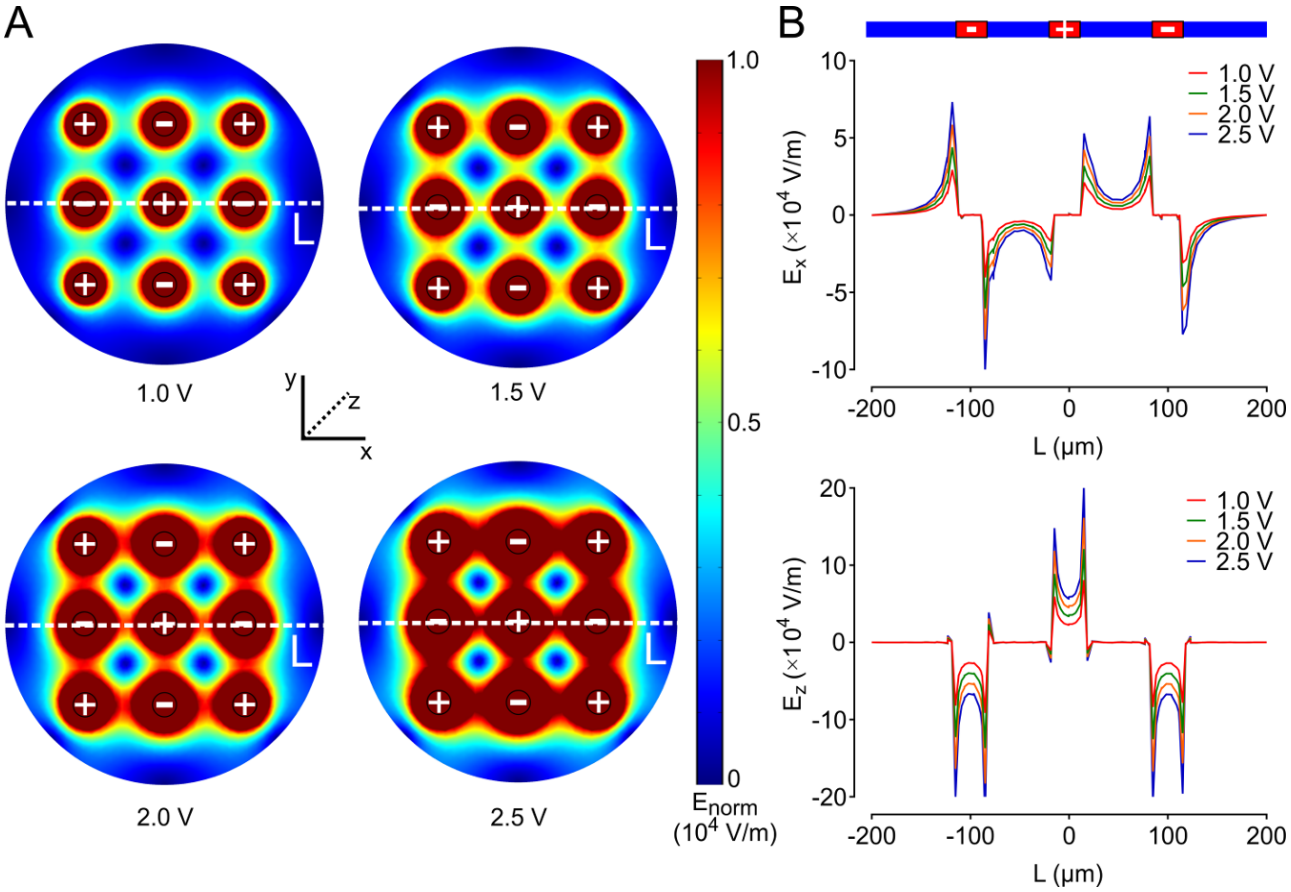

Fig. S4. Distribution of electric field in micro-electrode array (MEA) as calculated by finite element analysis. (A) Strength of normalized electric field in MEA increases as applied potential is increased (1, 1.5, 2, and 2.5 V) between neighboring electrodes (positively and negatively charged electrodes indicated by plus and minus signs, respectively). Electric field strength is indicated by a colorimetric range where the strongest (red regions) are near the electrodes and the weakest (dark blue regions) are midway between the electrodes. Coordinate axes scale bars: 100 μm. (B) Electric field strength (by convention: positive values indicate direction of force/movement for a positively charged particle) along the white dotted line, L, shown in panel A and for electrode arrangement shown above. Z-component of the field (Ez: upper) increases between electrode center to electrode edge (maximal) and is negligible away from electrodes. X- and y-components of the field (Ex, Ey: lower) are negligible over the electrodes but jump to a maximum at electrode edges and decrease away from electrodes. Models predict negatively charged particles will experience strongest force near electrode edges and gather there.

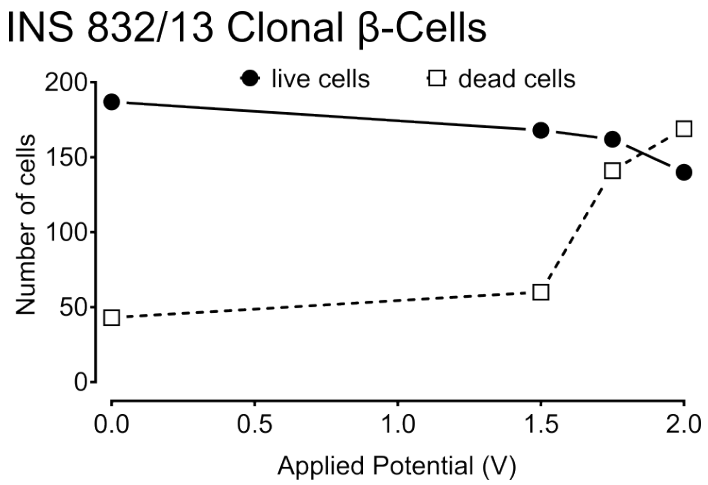

Fig. S5. Influence of applied potential on viability of clonal INS832/13 β-cells. Clonal INS832/13 β-cells on a micro-electrode array (MEA) were exposed to various electric potentials: 0, 1.5, 1.75, and 2.0 V for 10 min and cultured for 3 days. LIVE/DEAD Cell Imaging Kit was used to identify and count the number of live cells (black circles) and dying or dead cells (white squares) situated within a 200 μm radius from MEA electrodes.

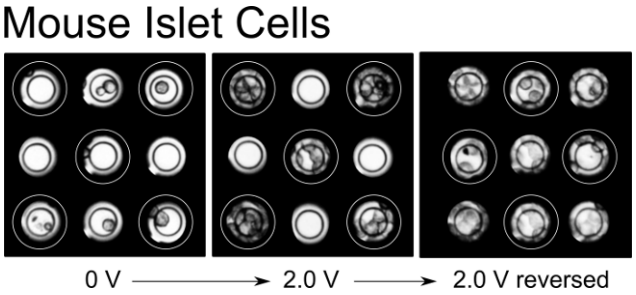

Fig. S6. Movement of mouse islet cells after reversal of electric field. Images showing coverage of microelectrodes with mouse islet cells. Left panel: immediately after loading cells. Middle panel: after exposure to a 2.0 V electric potential for 1 min (positively charged electrodes indicated by white rings and negatively charged electrodes unmarked). Right panel: electric field is reversed so that electrodes that were previously positive are now negative and vice-versa. Electrode diameter: 30 μm.

Table S1. Signal to noise ratio (SNR) of recordings comparing unfiltered signals to filtered (0.2-2Hz. Zero-phase Butterworth) signals with noise removed. Mean and SEM values for SNR in logarithmic scale (dB) shown for control (n=12) and treated (n=9) electrodes for two conditions: G15 (15 mM glucose) and G3+Glib (3 mM glucose with 100 nM Glibenclamide).

	Control		**Treated**	
Condition	Mean	SEM	Mean	SEM
G15	2.927	0.385	3.650	0.386
G3+Glib	4.232	0.529	5.215	0.404