Electrical Supplementary Information for

ASSESSMENT OF EFFECTS OF MULTI DRUG RESISTANCE ON DIELECTRIC PROPERTIES OF K562 LEUKEMIC CELLS USING ELECTROROTATION

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In the ER experiments the uniformly rotating electric field is generated by application of the four sinusoidal signals in phase quadrature to the quadrupole electrodes. Fig. S1 shows the schematic view of an ER device with polynomial electrodes. Upon to application of an electric field, polarizable particles present rotating behavior around the z axis. The direction of the rotation depends on the polarity of the imaginary part of the Clausius-Mossotti factor. This figure presents a manually mounted PDMS reservoir for holding the cells in the measurement region of the ER devices.

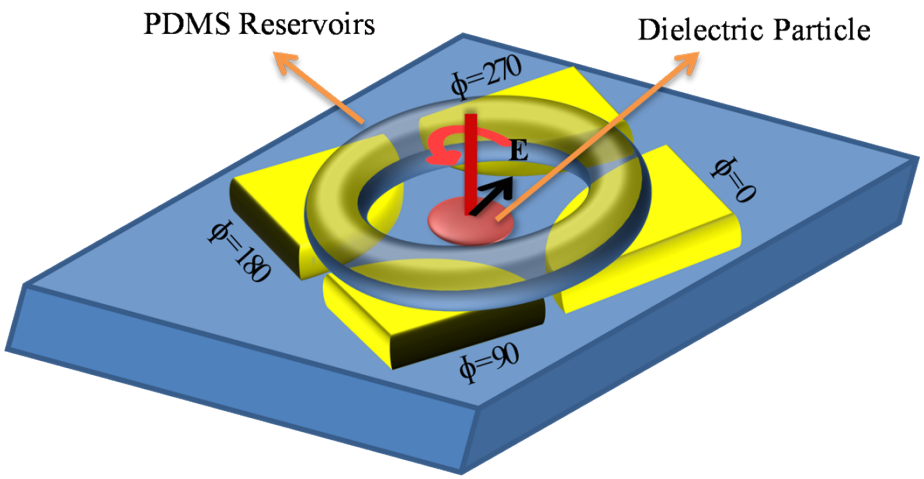

Fig. S1 Schematic view of an ER device. The direction of the rotating electric field upon application of sinusoidal voltages in phase quadrature, and the rotation of cells toward the direction of induced moment.

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Fig. S2a shows the electric field gradient intensity (∇E^2) distribution in the inter-electrode region of the ER devices with polynomial electrodes. The magnitude of the ∇E^2 over the device surface is described quantitatively in Fig. S2b. The positive DEP regions (pDEP) are located at the vicinity of the electrodes tips because of the higher intensity of the electric field. The intensity of the electric field decreases toward the center of the device. Therefore, due to repulsive negative DEP force (nDEP) cells are trapped in the center of the device. By forcing the cells toward the nDEP region, the lateral movements of cells are minimized.

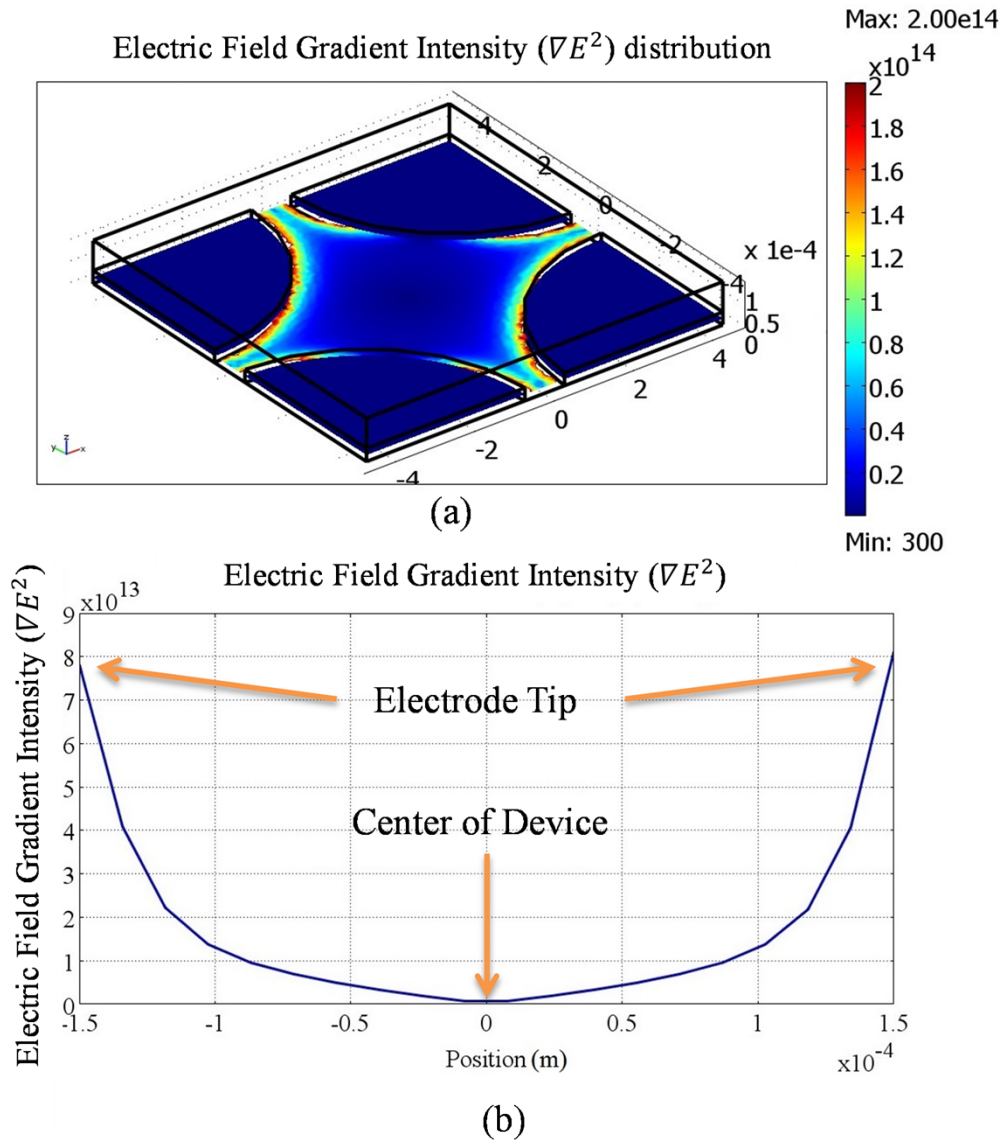

Fig. S2 (a) The electric field gradient intensity (∇E^2) distribution on the device surface. The region surrounding the electrodes is assumed to have conductivity of 3 mS/m and relative permittivity of 78. The applied sinusoidal voltage has an amplitude of 12.5 V_{PP}. The maximum electric field gradient is in the electrode tips. (b) Changes in electric field gradient intensity (∇E^2) magnitude between two opposite electrodes, the center of the electrodes has the minimum value of ∇E^2 (nDEP region). Under nDEP force, cells are being trapped in the middle of the electrode tips.

The ER spectrum of K562/DOX-0.1, 0.3, and 0.5 µM resistant cells in different medium conductivities, in the frequency range of 1 kHz – 0.1 MHz are shown in Fig. S3a-c. The ER spectrum of the K562 drug sensitive cells is shown in Fig. S4. The ER spectrums of the cells were used in determining the peak rotation frequency of the cells inside each medium. The obtained peak rotation frequencies were used in calculation of the dielectric properties of the cell interior and membrane.

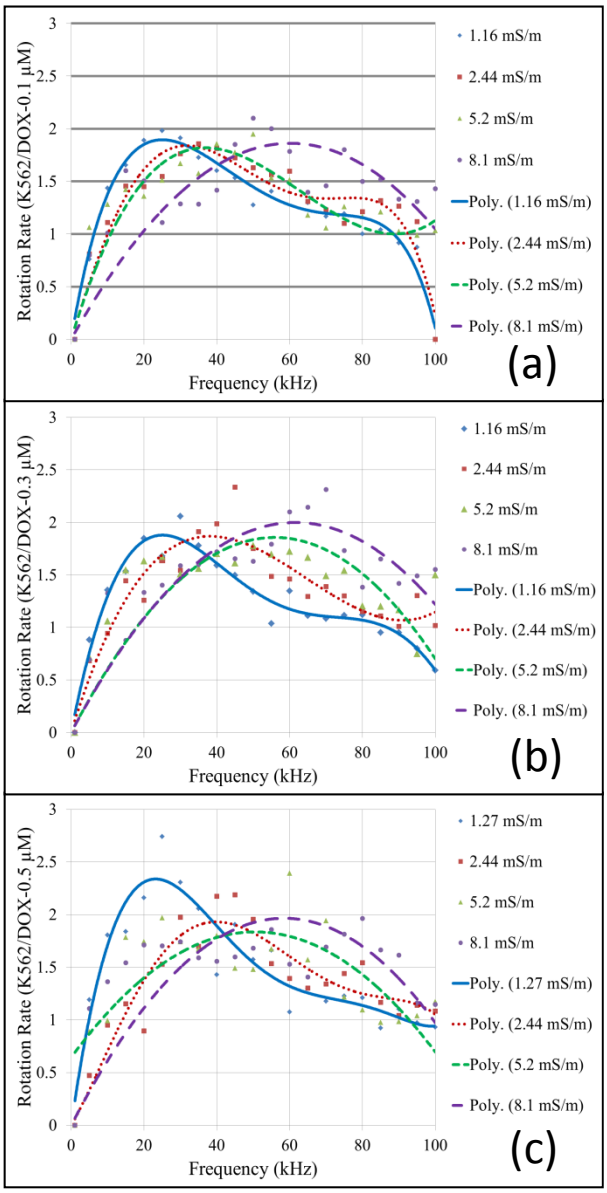

Fig. S3 Rotation rates of K562/DOX 0.1 (a), 0.3 (b), and 0.5 (c) µM cells in the frequency range of 1 kHz to 0.1 MHz, inside four different medium conductivities.

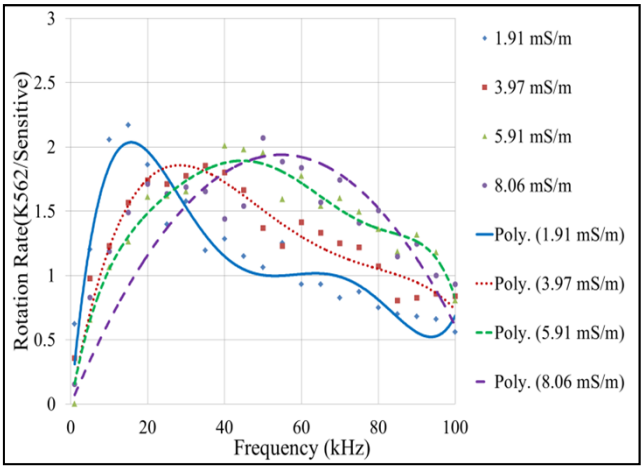

Fig. S4 Rotation rates of K562 sensitive cells in the frequency range of 1 kHz to 0.1 MHz, inside four different medium conductivities.