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Sequential Signal Generator for Yeast Separations

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The multiple-parallel plate electrode equipped with a sequential signal generator (SSG) (to be patented) has been developed for on-site yeast separations in the brewery industry. Dead and living yeast cells were separated by using non-uniform sinusoidal electric fields. The SSG was developed from our previous lab-scale version to produce a sinusoidal phase to generate out-of-phase electric fields for on-site operation with ranging frequency of 1 kHz-1 MHz and the output voltage range of 1-30V_{pp}. The phase difference addressing on the opposite electrodes are fixed as π radian and its phase sequence can automatically be altered and circulated within interval time of 30 seconds (changed by a step of 0.01-30 second). Experimental results showed that living yeast cells of the brewery company exposed in the electric field strength ranged from 14 to 143 kV.m^{-1} exhibited positive dielectrophoresis (cells attach to the electrodes) at the lower critical frequencies between 81.00-89.00 kHz (the optimized frequency was 82.43 kHz) if the medium conductivity (σ_s) was between 0.01-0.30 S.m^{-1}. These electrical conditions imply that yeasts being translated to the tip of electrodes were living cells. Percent yield of positive dielectrophoresis can be employed to evaluate the number either living or dead cells quantitatively. Moreover, the value of the lower critical frequency was shifted towards greater values when σ_s was increased. The spectra of both positive dielectrophoresis of the living and dead cells were different resulting in difference of cells dielectric properties i.e. the
conductivity of the yeast cytoplasm (σ_c) of the dead cell was less than that of the living yeast cells (typically, the living cell has a cytoplasmic conductivity of about 0.2 S.m^{-1}).

Author: BUNTHAWIN, Sakshin (Biotechnology of Electromechanics Research Unit, Science of Physics, Faculty of Technology and Environment, Prince of Songkla University, Kathu, Phuket 83120, Thailand)

Co-authors: TUANTRANONT, Adisorn (Nanoelectronics and MEMS Laboratory, National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA), Ministry of Science and Technology (MOST), Pathumthani 12120, Thailand); Mr JARUWONGRUNGSEE, Kata (Nanoelectronics and MEMS Laboratory, National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA), Ministry of Science and Technology (MOST), Pathumthani 12120, Thailand)

Presenter: BUNTHAWIN, Sakshin (Biotechnology of Electromechanics Research Unit, Science of Physics, Faculty of Technology and Environment, Prince of Songkla University, Kathu, Phuket 83120, Thailand)

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