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Dielectrophoretic Concentration of Cyanobacteria for Enhanced Raman Signal Acquisition in Water Monitoring

Raman spectroscopy provides label-free molecular information from microorganisms, but measurements of dilute suspensions are often limited by the small Raman interrogation volume and the low probability of probing sufficient biological material. Dielectrophoresis (DEP) can address this spatial limitation by actively concentrating microorganisms within a defined, Raman-accessible region [1,2]. In this work, we investigate simple and accessible DEP electrode fabrication methods for the preconcentration of cyanobacteria prior to conventional Raman analysis. Two fabrication approaches were evaluated on metal-coated substrates: mechanical scribing and laser ablation [3]. Numerical simulations and experimental DEP tests were performed using cultures of *Microcystis aeruginosa* under an applied AC field, with frequencies ranging from 10 to 100 kHz and an amplitude of 10 Vpp (Figure 1). Consistent with the simulations, *M. aeruginosa* cells exhibited positive dielectrophoresis (pDEP) at 10 kHz, whereas negative dielectrophoresis (nDEP) was observed at 100 kHz under the tested conditions. These preliminary results support the feasibility of simple and rapid electrode fabrication strategies for DEP-assisted Raman measurements and their potential integration into field-deployable platforms for water quality monitoring.

References

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Figures

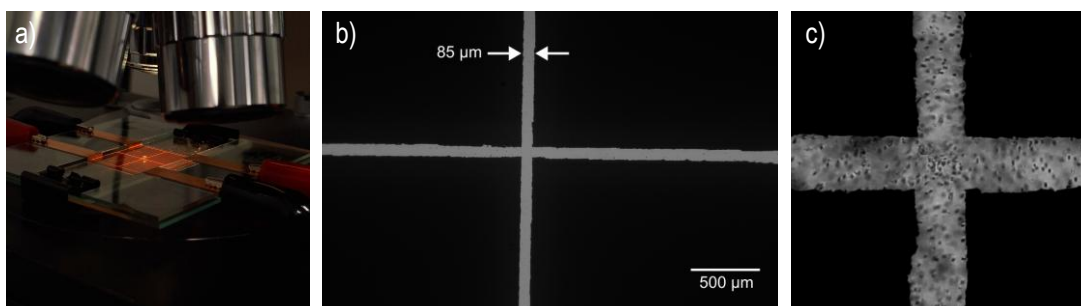


Figure 1: (a) Experimental setup, (b) fabricated electrodes, and (c) *Microcystis aeruginosa* cells during DEP experiments.