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Borja García García[1,2]
María Gabriela Fernández-Manteca[1,2], Celia Gómez Galdós[1,2], Ana Sobrino-Santos[1,2], Susana Deus Álvarez[3], Agustín P. Monteoliva[3], José Francisco Algorri[1,2,4], Adolfo Cobo[1,2,4], Luis Rodríguez-Cobo[1,2,4]
[1] Photonics Engineering Group, Universidad de Cantabria, 39005, Santander, Spain
[2] Instituto de Investigación Marqués de Valdecilla (IDIVAL), 39011, Santander, Spain
[3] Ecohydros S.L., 39600, Maliaño, Spain
[4] CIBER-BBN, Instituto de Salud Carlos III, 28029, Madrid, Spain

borja.garcia@unican.es

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 kHz to 10 MHz and an amplitude of 10 Vpp (Figure 1). Consistent with the simulations, *M. aeruginosa* cells exhibited negative dielectrophoresis (nDEP) at 10 kHz, whereas positive dielectrophoresis (pDEP) was observed at 10 MHz 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

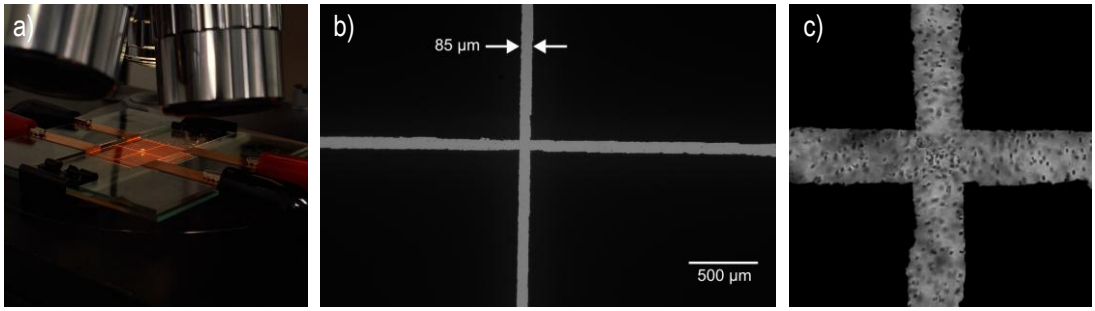

Figure 1: (a) Experimental setup, (b) fabricated electrodes, and (c) *Microcystis aeruginosa* cells during DEP experiments.