Call for Semester Project Student

Characterization of Ultrasound-Activated Piezoelectric Microbeads for Bioelectronic Applications

Fields: Bioengineering | Neuro-X | Electrical engineering | Microengineering

Project Overview

This project focuses on the experimental characterization of ultrasound-activated piezoelectric composite microbeads developed via microfluidics for bioelectronic applications [1]. While these microbeads, embedding piezoelectric ($BaTiO_3$) and magnetic (Fe_3O_4) nanoparticles, have already demonstrated controlled fabrication and magnetic actuation, their piezoelectric response remains unquantified. The goal is to investigate how effectively they convert ultrasound into electrical signals, a key step toward enabling wireless neural stimulation and other minimally invasive biomedical technologies. By bridging this gap between material fabrication and functional performance, the project contributes to wireless, minimally invasive neural interfaces.

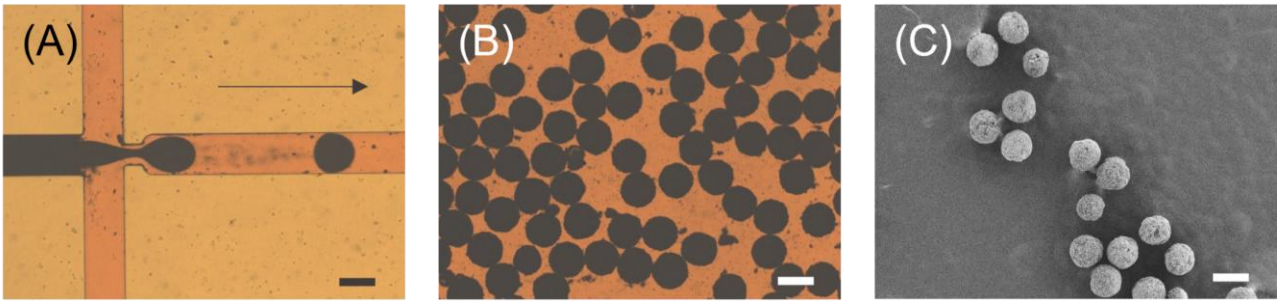

Fig. 1. Microfluidic synthesis of composite microbeads encapsulating 20 wt% piezoelectric ($BaTiO_3$) and 5 wt% magnetic (Fe_3O_4) particles. (A) Optical image of the microfluidic junction illustrating droplet generation in the dripping regime. (B) Droplets collected prior to UV curing. (C) SEM image of the solidified beads. Scale bars: 100 µm.

What You'll Work On

Tasks will be tailored to your background and interests and may include:

- Set up and optimize an ultrasonic actuation for stimulating microbeads
- Measure the piezoelectric electrical response (current/voltage) under ultrasound
- Perform parameter sweeps of ultrasound frequency and intensity
- Study how microbead quantity/concentration affects electrical output
- Analyze experimental data to identify trends and scaling behavior

Why Join?

- Cutting-edge research teams in microfluidics and bio-applications
- Opportunity to contribute to ongoing research and potentially to a publication

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[1] Han, Mertcan, et al. Nature Communications 15.1 (2024): 2013.

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