PÔSTER - RESUMO - SENSORES E BIOSSENSORES

WETTABILITY CONTROL FOR ADVANCED SENSING

Antonio Riul Jr (riul@unicamp.br)

Maria Helena Gonçalves De Souza (mariahelenags10@gmail.com)

Endel Ezequiel Carvalho Costa (e184127@dac.unicamp.br)

Cross-contamination and fouling are recurring problems in prolonged analyses of liquid systems. They lead to the formation of biofilms or material deposition on the sensing units of devices, such as electronic tongues, compromising performance, measurement accuracy, and data integrity. This project proposes the development of films that enable advanced wettability control, creating superhydrophobic surfaces and SLIPS (Slippery Liquid-Infused Porous Surfaces) for use as multifunctional sensing units in our devices. We will do this through the Layer-by-Layer (LbL) technique as it offers precise control over film thickness, nanoarchitecture, chemical versatility, optical transparency (if desirable), and stability. Our aim is apply the LbL structures to form superhydrophobic and SLIPS sensing units for the analysis of oil-based systems (pharmaceuticals) and soil samples for precision agriculture. We intend to reduce cross-contamination and measurement time, and to increase the reliability, robustness, lifespan, and applicability of these devices, even in continuous monitoring for more than 1 week (a period during which incrustations usually completely take down the sensing units). Currently, two-thirds of the total measurement time is spent cleaning the devices to prevent cross-contamination, and partners at FIOCRUZ Farmanguinhos challenged us to analyze oil-based cannabis extracts, which we are currently unable to do. In

our search for solutions, we found that no research group or company working on e-tongues is investigating this wettability control in the sensing units. If achieved, it will reduce the need for intermittent cleansing, minimize cross-contamination, biofilm formation, and incrustations, optimize analysis time, and increase the possibility of continuous monitoring. We already achieved superhydrophobicity in two sensing units, with promising results in the separation of basic tastants and samples prepared by colleagues at Fiocruz Farmanguinhos (RJ). The challenges multiply when we look at the frontier of knowledge, where wearable and implantable sensors require flexibility, biocompatibility, conformability, and operational stability in contact with biological fluids. In this sense, we can extract information from sweat, with LbL films being good candidates for future health monitoring from the skin without compromising comfort or signal fidelity. These developments can pave the way for innovations in impedance sensing for human and also plant monitoring, which generally occur in the range of 0.1 Hz – 300 Hz. In this regard, we are seeking a partnership with Prof. Hana Uršic (Slovenia) to integrate superhydrophobicity with piezoelectricity to develop state-of-the-art wearable sensors, which are also of interest to INEO.

Acknowledgements: FAPESP 2025/27044-5, CNPq 408449/2024-1, INEO

Palavras-chave: layer-by-layer; wettability; superhydrophobic; e-tongue.