

Comparison of Passivation Layers for the Reliability of Microelectrodes

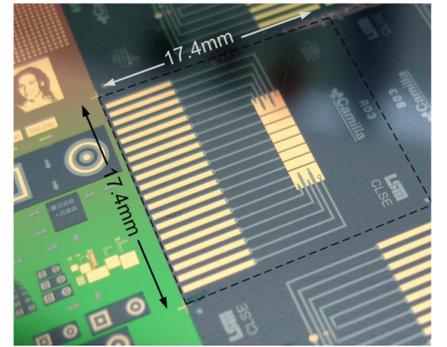
Yuksel Temiz^{1,2}, Anna Ferretti¹, Carlotta Guiducci¹

¹Laboratory of Life Sciences Electronics (CLSE) - Ecole Polytechnique Fédérale de Lausanne (EPFL)
²Microelectronic Systems Laboratory (LSM) - Ecole Polytechnique Fédérale de Lausanne (EPFL)

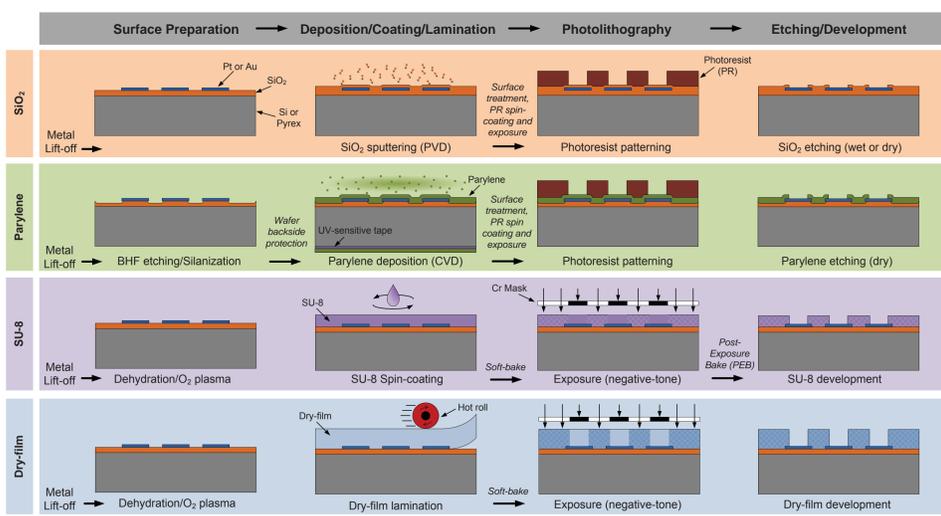


INTRODUCTION

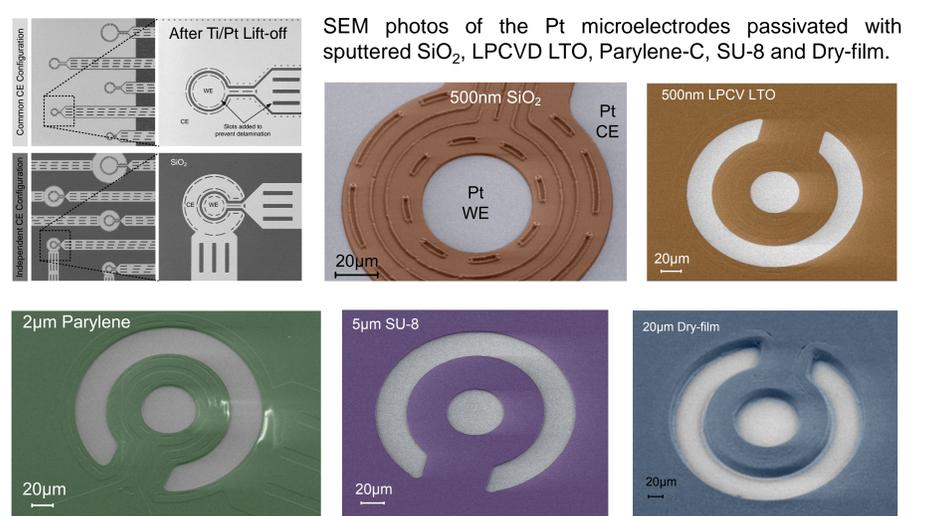
This work presents the reliability tests of different passivation layers used in microelectrodes for biosensing applications. Pt microelectrodes with sputtered SiO₂, LPCVD low-temperature oxide (LTO), Parylene-C, SU-8, and dry-film passivations are fabricated. The robustness of the microelectrodes is first tested through hydrolysis tests; then, the reliability is tested by statistical impedance measurements before and after self-assembled monolayer (SAM) formation. It is verified that Parylene-C and SU-8 outperform the other passivation layers in terms of reliability. Also, repeatable electrochemical label detection is demonstrated with the parylene passivated chips. *Y. Temiz et al., Lab on a Chip (submitted)*



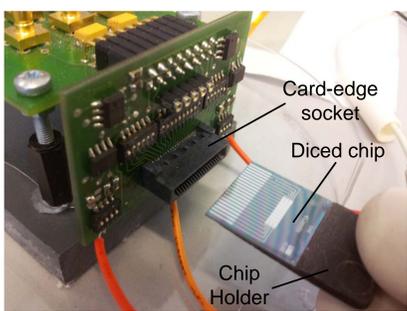
Fabrication Process



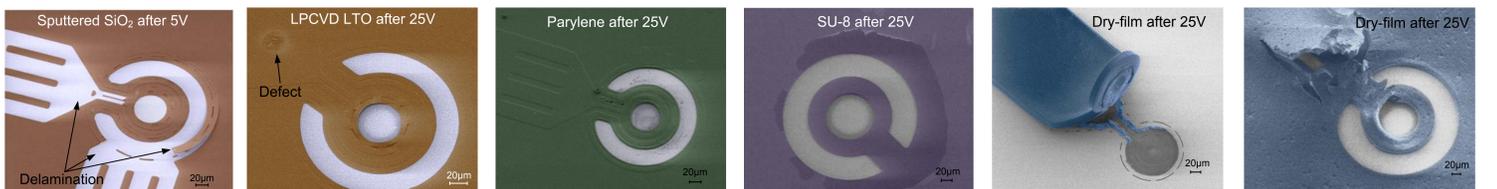
Fabricated Microelectrodes



Hydrolysis Tests

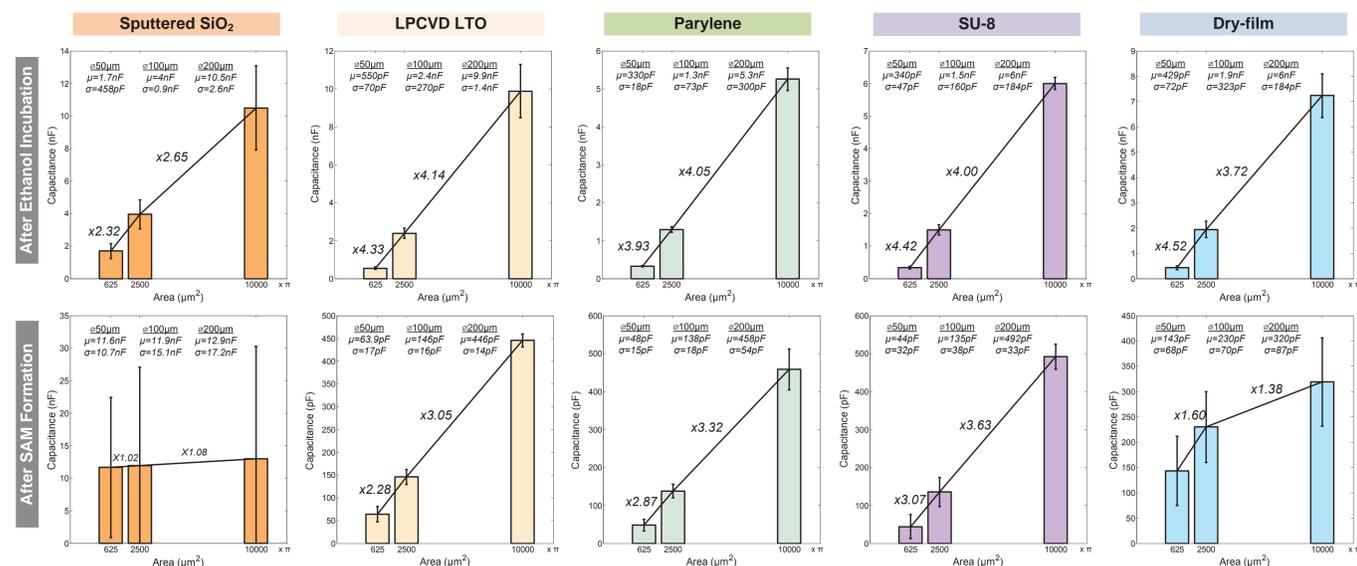


A DC potential ranging from 1 V to 25 V is applied between the WE and CE, as the electrodes are immersed into phosphate buffered saline (PBS) solution. As the voltage is gradually increased, bubble formation is inspected visually, and the SEM images are taken to validate the quality of the passivation layer. Throughout the tests, SU-8, Parylene-C and LTO demonstrate good passivation properties without any visible delamination. Dry-film resist, however, occasionally shows delamination in the independent-CE electrodes, and local cracking in common-CE electrodes. In the case of sputtered SiO₂, serious delamination is observed even at much lower voltages.



Measurements

The first row corresponds to the capacitance values measured after overnight ethanol incubation and the second row gives the values after overnight thiol incubation. Three bars in each plot correspond to 50 μm, 100 μm, and 200 μm diameter WEs. Mean (μ) and standard deviation (σ) values of 24 electrodes per passivation per size are given as inset information.



Parylene passivated Pt microelectrodes are incubated with electroactive thiols functionalized with ferrocene. For the electrodes having thiols without ferrocene, a flat response is observed, on the other hand, in the presence of ferrocene, a very distinct peak is detected.

