Development of a Biomembrane Platform for the Study of Virus Infection

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Primary CNF Tools Used: Heidelberg Mask Writer - DWL2000, ABM Contact Aligner, Odd-Hour E-beam Evaporator, Oxford PECVD, PT 740 Etcher, DISCO Dicing Saw, Bruker AFM

Abstract:

As a "label-free" alternative to optical sensing, electrical sensing represents a more feasible, reproducible, and scalable detection method [1,2]. Among various electrical sensing techniques, the non-invasive electrochemical impedance spectroscopy (EIS) technique is especially suitable for accurately quantifying the bio-recognition events occurring at a variety of biointerfaces, such as bacterial, viral, cellular and synthetic lipid membranes [3,4]. Our group aims to design a microelectrode system that will support the self-assemble of supported lipid bilayers (SLBs) on the electrode surfaces, and their electrical properties (resistance, capacitance) can be extracted by applying an alternating voltage and recording the current response [4-7]. Since the electrode dimensions and the local environment are readily controlled via photolithography, this system gives us a edge to easily mimic and manipulate the local environment to support the assembly of various SLBs of interest. Future work will focus on the incorporation of the microfluidic system into the microelectrode system.

Summary of Research:

To fabricate the microelectrode devices, photomasks were created using the Heidelberg Mask Writer - DWL2000, and used with the ABM contact aligner to pattern photoresist that was spun onto a fused silica wafer. A first layer of gold contact pad was patterned following the developing of SPR220 3.0 photoresist and the deposition of Au thin film. A thin layer of SiO_2 insulating layer is then deposited directly on top of the Au contact pad using Oxford PECVD.

Electrode area was then patterned on SiO_2 following the spin-coating and developing of the second layer of photoresist. PT-740 etched was then used to etch the exposed SiO_2 until Au contact pad has been exposed. A conductive polymer, PEDOT:PSS was then spun over the fused silica wafer followed by the deposition of a germanium (Ge) hard mask (odd-hour evaporator). A third layer of photolithography was performed on a layer of negative photoresist spun on top of Ge, where all resists above Ge at areas outside active electrode surface have been developed.

Unprotected Ge and PEDOT:PSS underneath were then etched using PT-740. Ge on top of active electrode area was then etched in water bath overnight.

Once the microelectrode device was fabricated, a PDMS well was stamped directly on top to create a reservoir for SLB self-assembling and allow EIS measurement.

References:

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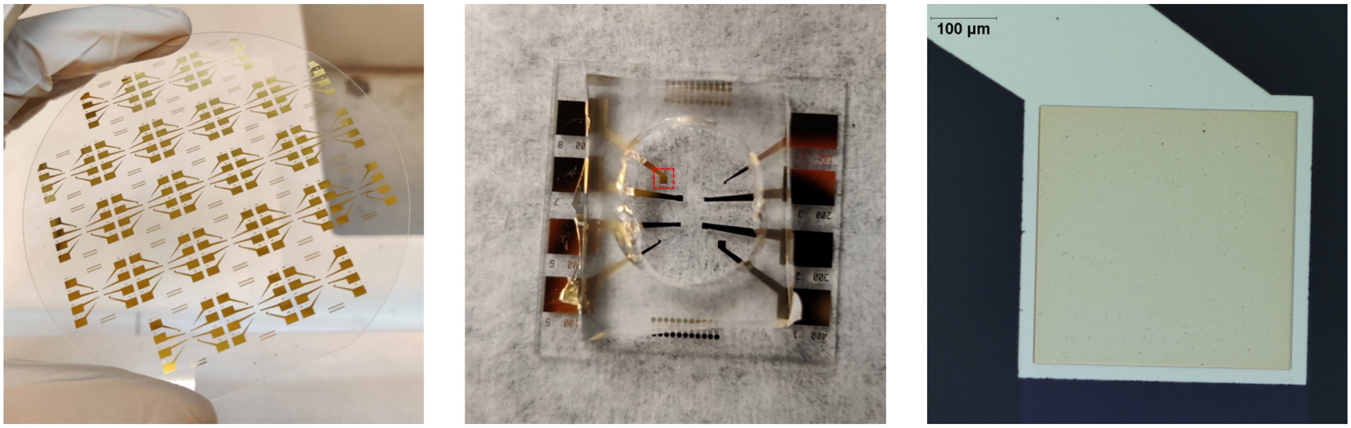

Figure 1: Microelectrode devices on a fused silica wafer (left); PDMS well stamped on a single device to enable self-assembling of SLB and EIS measurement (middle) and zoomed in figure to show PEDOT:PSS electrode on Au contact pad (right).