Development of a Biomembrane Platform for the Study of Virus Infection

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Primary CNF Tools Used: Heidelberg DWL2000 Mask Writer, 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 lipid vesicles (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]. We have recently demonstrated such platform can be used to recreate viral infection of host cell and can differentiate different virus mutations [8]. Future work plan to incorporate microfluidic system with the microelectrode system.

Summary of Research:

To fabricate the microelectrode devices, photomasks were created using the Heidelberg DWL2000 Mask writer 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 S1813 photoresist and the deposition of Au thin film. A thin layer of SiO2 insulating layer is then deposited directly on top of the Au contact pad using Oxford PECVD. Electrode area was then patterned on SiO2 following the spin-coating and developing of the second layer of photoresist. PT-740 etched was then used to etch the exposed SiO2 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 hard mask (odd hour e-beam evaporator). A third layer of photolithography was performed on a layer of negative photoresist (nLOF 2020) spun on top of Ge, where all resists above Ge at areas except active electrode surface were 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 following EIS measurement.

References:

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