Sugar Sensing by Native and Chemically Modified Silicon Nitride Nanopores

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Sugars are unavoidable in daily life, from the surface of our cells to the suggested masses displayed on the nutritional information labels of our food. The chemical structures of isolated polysaccharides are often highly varied and require complex and expensive analytical instrumentation to decipher. Because of this, it is desirable to develop more affordable devices that can still quickly and reliably reveal this information. Solid state nanopores are starting to demonstrate their potential to make this a reality. Further development of these devices could lead to advances in sensing capabilities for applications in glycomics.

In this work, nanopores are fabricated on thin film silicon nitride (SiNx) membranes by di-electric breakdown. In short, two wells containing an electrolyte solution with a voltage potential between them are isolated by an individual membrane, eventually resulting in a single pore with nanometer dimensions. Once formed, the conditions of the electrolyte solution are tuned to alter the chemical conditions on the surface of the pore and the analyte of interest to produce ideal parameters for translocation under an applied electric field. Achieving better selectivity and sensitivity to specific species is accomplished by surface chemical modification leading to unique and novel sensing abilities.

Robust methods of chemical functionalization have been developed for extensive customizability of the nanopore surface. These devices are currently being used to analyze polysaccharides, peptides, carboxylic acid capped gold nanoparticles, and the interactions between them.