Optimizing the measurement of DNA Translocation in Solid-State Nanopores

Chen-Chi Chien[1], **Siddharth Shekar**[2], **David J. Niedzwiecki**[1], **William Parkin**[1], **Kenneth L. Shepard**[2], **Marija Drndic**[1]
[1]University of Pennsylvania, Philadelphia, Pennsylvania, USA
[2] Columbia University, New York City, New York, USA
E-mail: chienc@sas.upenn.edu

Nanopores have a broad applicability as single-molecule sensors because of their spatiotemporally localized transduction and high intrinsic gain. In this work, we seek to increase the bandwidths accessible to nanopore measurements through improvements to nanopores, associated measurements electronics, and their integration. Solid-state pores, in particular, can generate signals that are often more than one order of magnitude larger than their biological counterparts. These larger signals make solid-state pores much more amenable to high-bandwidth measurements. Earlier work[1] showed DNA translocation measurements with sub-microsecond temporal resolution using silicon nitride nanopores. In this work, we further improve the temporal resolution to 100 ns by a recently developed CMOS nanopore amplifier[2] (CNP2) with 10 MHz bandwidth capacity using silicon nitride pores thinned with electronic beam techniques to < 3 nm thickness[3], with pore diameter comparable to the diameter of ssDNA. To further reduce C_{pore}, we have previously reported nanopore fabrication on fused-silica based platform[4], with C_{pore} < 1 pF. Here we present data from combining our custom electronics with these low-capacitance, high-conductance ultra-thin pores.

References

[1] Rosenstein, J. K.; Wanunu, M.; Merchant, C. a; Drndic, M.; Shepard, K. L. Integrated Nanopore Sensing Platform with Sub-Microsecond Temporal Resolution. *Nat. Methods*, ***9***, 487–492. (2012)

[2] Shekar, S.; Niedzwiecki, D. J.; Chien, C.-C.; Ong, P.; Fleischer, D. A.; Lin, J.; Rosenstein, J. K.; Drndic, M.; Shepard, K. L. Measurement of DNA Translocation Dynamics at 100 ns Temporal Resolution. *Nano Lett.*, ***16*** **(7)**, 4483–4489 (2016).

[3] Rodríguez-Manzo, J. A.; Puster, M.; Nicolaï, A.; Meunier, V., and Drndic, M. DNA Translocation in Nanometer Thick Silicon Nanopores. *ACS Nano*, ***9*** **(6),** 6555–6564 (2015)

[4] Balan, A.; Chien, C.-C.; Engelke, R.; Drndic, M. Suspended Solid-state Membranes on Glass Chips with Sub 1-pF Capacitance for Biomolecule Sensing Applications. *Scientific Reports* ***5***, 17775 (2015)