Controlling Light, Temperature, and Force in Nanopores for Single-Biomolecule Analysis

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In recent years, nanopores have gained attention as molecular counters, able to detect various species from the smallest of ions to large macromolecules. Nanopores have particularly enjoyed the spotlight due to their ability to linearly scan information content encoded in nucleic acids, and currently, nanopores are an integral part of the MinIon, a device commercialized by Oxford Nanpore Technologies for single molecule DNA and RNA sequencing. In this talk, I will discuss two other uses of nanopores in the *biophysics and biotechnology* space: First, I will describe our discovery of an optothermal effect that occurs in solid-state nanopores, in which a laser can induce a rapid temperature change localized to the nanopore. Using this effect, individual biomolecules can be subjected to a temperature ramp within millisecond timescales, allowing us to probe their thermal stability under a nanopore-induced electromotive force. Second, I will discuss how introducing nanopores into optical waveguide cavities results in orders of magnitude enhancement of DNA capture of various lengths, and further, removes short read bias by attracting long DNAs into the waveguides with equal or better efficiency. Removing the length bias, allows us to optically sequence long DNA fragments at picogram DNA levels.**[2]**

[1] Yamazaki et al., *Label-Free Single-Molecule Thermoscopy Using a Laser-Heated Nanopore*, **Nano Letters**, 2017
[2] Larkin et al., *Length-independent DNA packing into nanopore zero-mode waveguides for low-input DNA sequencing*, **Nature Nanotechnology**, 2017