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Single molecule thermodynamics and nanopore-based thermometry JOSEPH E. REINER, Physics Department, Virginia Commonwealth University, JOSEPH W.F. ROBERTSON, Physical Measurement Laboratory, NIST, LISA K. BURDEN, Biology Department, Wheaton College, DANIEL L. BURDEN, Chemistry Department, Wheaton College, JOHN J. KASIANOWICZ, Physical Measurement Laboratory, NIST — The nanopore-based resistive pulse method measures the reduction in ionic current caused by the interaction of single molecules with the pore. It has great promise in addressing problems across a range of fields that include biomedicine and genomics. The technique requires the residence time of the molecules in the pore to exceed the inverse bandwidth of the detection system ($\sim 10\ \mu$s). Efforts are underway to improve this by molecular modification of the pore wall, but little effort has focused on modifying the solution conditions in and around the pore. We address this issue by precisely controlling the solution temperature around a protein ion channel (alpha hemolysin) via laser-induced heating of gold nanoparticles. In this technique, the nanopore serves dual roles as both a highly local thermometer and single molecule sensor. Preliminary data suggests that the solution temperature can be controlled over a wide range, the nanopore conductance can be used to directly measure rapid changes in temperature, and the temperature change can dramatically alter the interaction kinetics of single molecules with the nanopore. The method will improve the development of biochip sensors and lead to a new platform for single molecule thermodynamic studies.

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