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Diffusion, Surface Kinetics, and Detection in Solid-State Nanopores DAVID HOOGERHEIDE, SLAVEN GARAJ, JENE GOLOVCHENKO, Harvard University — Solid-state nanopores are promising sensors for single biomolecules. Most sensing applications rely on electronic detection of changes in the ionic transport through or across the nanopore in the 0.1–10 kHz frequency band. Our recent studies of the electronic noise properties of silicon nitride nanopores highlight both the suitability of nanopores for physical measurements and their limits of detection (PRL 102, 256804 (2009)). We explore the dependence of excess white noise, which is dominant at detection frequencies, on electrolyte concentration, temperature, and pH. We detect two distinct processes: number fluctuations and surface charge fluctuations. Number fluctuations arise from carrier diffusion through the nanopore and represent a fundamental limit of voltage-driven detection techniques. This sort of noise is minimized at high electrolyte concentrations in low viscosity solutions. In addition, the interaction of ions in the solution with the surface produces fluctuations in the surface charge, and hence the conductance. This noise varies strongly with pH. Both are masked by 1/f noise at low frequencies. The usefulness of these noise sources for measuring physical constants such as diffusivity and reaction kinetics will be discussed.

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