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Thinning silicon-based membranes with electron irradiation for solid-state nanopore sensors[1] JULIO ALEJANDRO RODRIGUEZ-MANZO, MATTHEW PUSTER, University of Pennsylvania, Department of Physics and Astronomy, ADRIEN NICOLAI, VINCENT MEUNIER, Rensselaer Polytechnic Institute, Department of Physics, Applied Physics, and Astronomy, MARIJA DRNDIC, University of Pennsylvania, Department of Physics and Astronomy — We present a controlled electron irradiation-based method to thin free-standing amorphous silicon membranes to less than 2 nm. Thinning is carried out in a scanning transmission electron microscope using a 200 keV electron probe to sputter silicon atoms. The transmitted electrons, scattered elastically and inelastically, are used as feedback signals to monitor and control the thinning process with sub-nanometer precision. Solid-state nanopore single-molecule sensors were fabricated by drilling a nanopore in the thinned membranes with the electron probe. These sensors operate in aqueous electrolyte and register passage of individual molecules by measuring changes in ionic conductance. We show that these solid-state nanopore single-molecule sensors sustain changes in ionic conductance with signal-to-noise ratios close to 100 at 100 kHz for translocations of double-stranded DNA in 1 M KCl electrolyte at room temperature coupled with conductance blockade of 60-95%.

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