

SPICE-Circuit Simulation of the Electrical Response of a Semiconductor Membrane to a Single-Stranded DNA Translocating Through a Nanopore

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Abstract

We describe a circuit-element model for the electric detection of biomolecules in translocation through a nanopore in a SOS semiconductor membrane. The biomolecules are simulated as a superposition of individual charges moving through the nanopore and inducing a charge variation on the membrane electrodes that is modeled as a current source. The SOS membrane is discretized into interconnected elementary circuit elements. The model is tested on the translocation of 11 base single-stranded *C3AC7* DNA molecule, for which the electric signal shows good qualitative agreement with the multi-scale device approach of Gracheva *et al.*, while quantifying the low-pass filtering in the membrane. Overall, the model confirms the possibility of identifying electrically the sequence of the DNA bases.

Keywords - Circuit modeling, DNA sequencing, solid-state nanopore, SPICE simulation