Selective protein binding using a solid-state nanopore placed into a microfluidic device

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Abstract

Solid-state nanopores are a promising tool to detect and characterize biomolecular interactions in a controlled environment[1], amongst them DNA sequencing[2,3], detection of pathogens[4,5] and mass spectrometry for polymers and oligonucleotides[6,7]. Their nanometric diameter can be tunable to fit the analyte size and they present better chemical and mechanical stability than the biological ones[8,9]. However the interactions between nanoparticles and the nanopore are not well stablished, and the membrane has a short experimental lifetime attributed to a high surface energy. To overcome these challenges, we propose a polymer functionalization to better control the pore size, to passivate the membrane, hence avoiding nonspecific interactions of nanoparticles, by manipulating the chemical and physical surface properties[8,9]. Furthermore, to increase the specificity, a receptor can be immobilized on the nanopore surface to capture the target molecule[1,5], leading to an active sensor. The nanopore chip was inserted into a microfluidic device to facilitate its handling and protect it. The proof of concept was be done using the streptavidin-biotin complex, where the streptavidin was captured by the grafted biotin[10].

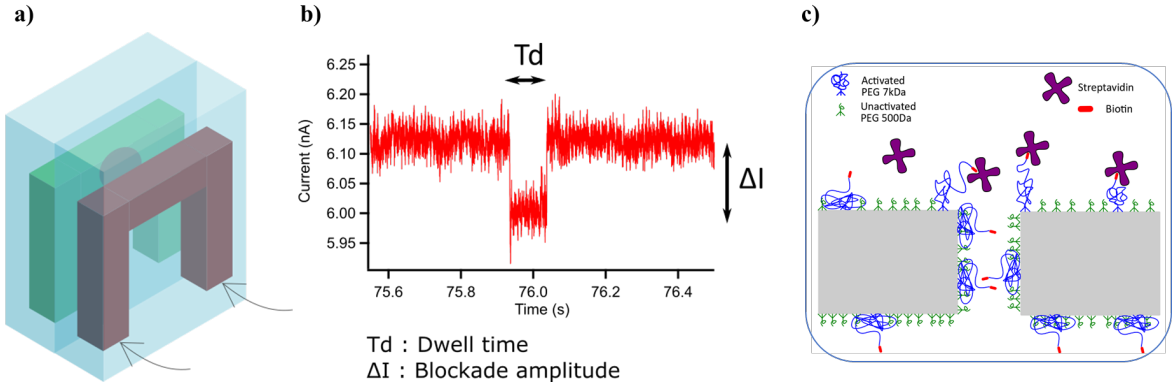

Fig. 1 a) Microfluidic device with a nanopore chip placed on it. b) Current blockade when a streptavidin molecule transiently resides inside a functionalized nanopore. c) Streptavidin interactions with a nanopore grafted with short and biotinylated long polymer (PEG) chains.

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