Nanopores as single-molecule tools in nanobiotechnology

David Rodriguez-Larrea

Instituto Biofisika, University of the Basque Country – CSIC. Barrio Sarriena s/n, Leioa 48940, Spain

david.rodriguezl@ehu.es

Abstract

A single nanometer wide aperture made in an electrically insulating membrane can be used as a single-molecule sensor by monitoring the ionic current flowing through the pore (Figure 1). The measurements are exquisitely sensitive, modulated by the atomic structure of the analyte at the lumen of the pore, and allow single-molecule DNA sequencing as a DNA strand translocates the nanopore in single-nucleotide steps.

Here I will show the research we are doing to analyse proteins [1] (Figure 2), manipulate proteins and, ultimately to sequence single-protein molecules [2]. We are also exploring the use of nanopores as single-molecule barcode readers [3] that, in addition to the barcode read provides and additional biophysical measure on the barcoded molecule of utility in drug-discovery and multiplexed diagnostics.

References

[1] Rodriguez-Larrea D & Bayley H, Nature Nanotechnology (2013)

[2] Rosen CB, Rodriguez-Larrea D* and Bayley H*. Nature Biotechnology (2014)

[3] Celaya G, Perales-Calvo J, Muga A, Moro F, Rodriguez-Larrea D. ACS Nano (2017)

Figures

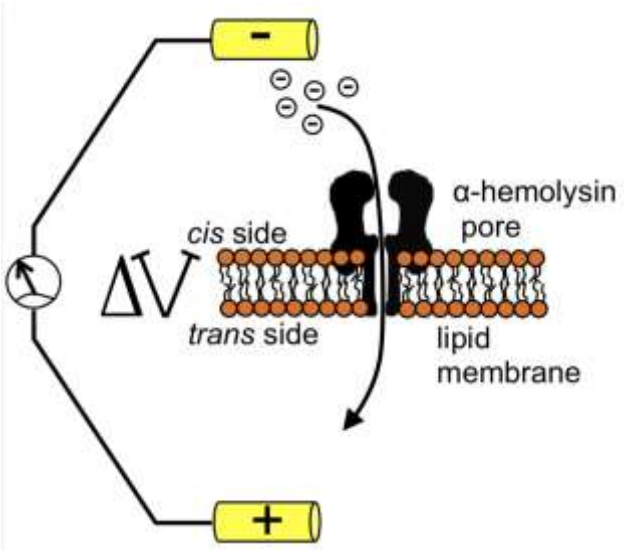

Figure 1: A single nanopore inserted in a lipid membrane allows the flow of ions in response to an applied electric potential. The ionic current can be measure with fine detail, and analytes detected if they decrease the current when threaded into the pore.

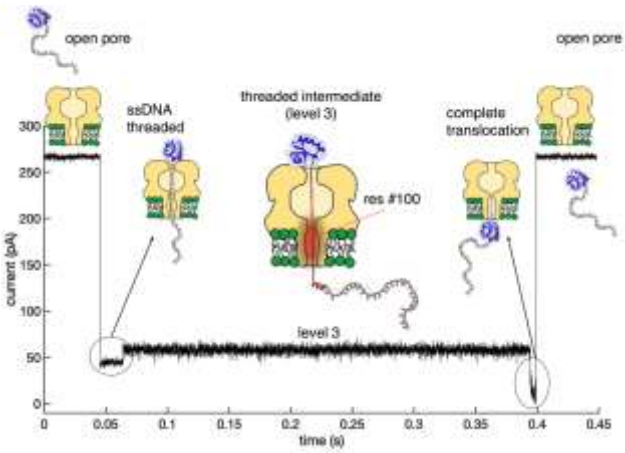

Figure 2: Ionic current signal obtained when a single protein molecule (blue) covalently attached to a ssDNA translocates a hemolysin membrane nanopore. The figures show the molecular structures associated to each step of the signal.