Hybrid biological-artificial nanopore based on biological channel confinement inside a track-etched nanopore

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The main challenge in the area of artificial single nanopores prepared by track-etched polymer sheets or transmission electron microscopy irradiation of thin silicon nitride film consists of mimicking biological channels.[1] In this context, the recent demonstration of the feasibility of hybrid biological/artificial solid-state nanopores by direct insertion of biological channels is likely the most original and promising way.[2] This strategy aims to combine the advantages of both solid-state nanopores (robustness, number, size and shape control) and biological channels (selectivity, precise structure).[3]

Here we will discuss about biological/artificial membrane based on membrane protein confinement inside single pore PET track-etched nanopore. Firstly, we will show that how the diameter pore size affects the ionic transport of gramicidin A (gA). Indeed when the gA is confined inside nanopores (10.6 nm, 5.7 nm, ~2 nm), its exhibits an anionic behavior explained by the loss of gA head-head dimer structure. The conductance measurements reveal for the first time an enhanced ionic transport mechanism through gA inside a polymeric solid state nanopore as in biological membranes.[4] However, the trend observed when decreasing the pore size might leave hopefully possibilities to transpose biological mechanisms of ionic transport when an ionic channel is directly confined inside a synthetic nanopore. Secondly, we will show the insertion of a-hemolysin and the potentiality in DNA sequencing applications. This hybrid system exhibits the same polynucleotide discrimination properties than α-hemolysin in biological membrane. Furthermore the hybrid nanopore permits to increase both the polynucleotide dwell time and nanopore lifetime.[5] Above those results the ability to insert a working protein inside a synthetic nanopore opens new leads in the field of research in nanobiotechnologies.

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[1] Z. Siwy and S. Howorka, Chem. Soc. Rev. **39**, 5067 (2010)
[2] S. Balme *et al*. Nano Letters **11**, 712 (2011)
[3] S.W. Kowalczyk, T.R. Blosser and C. Dekker, Trends in Biotechnology **29** 607 (2011)
[4] A. Abou-Chayaa *et al.* J. Phys. Chem. C **117** 15306 (2013)
[5] S. Cabello-Aguilar *et al.* Nanoscale **5** 9582 (2013)

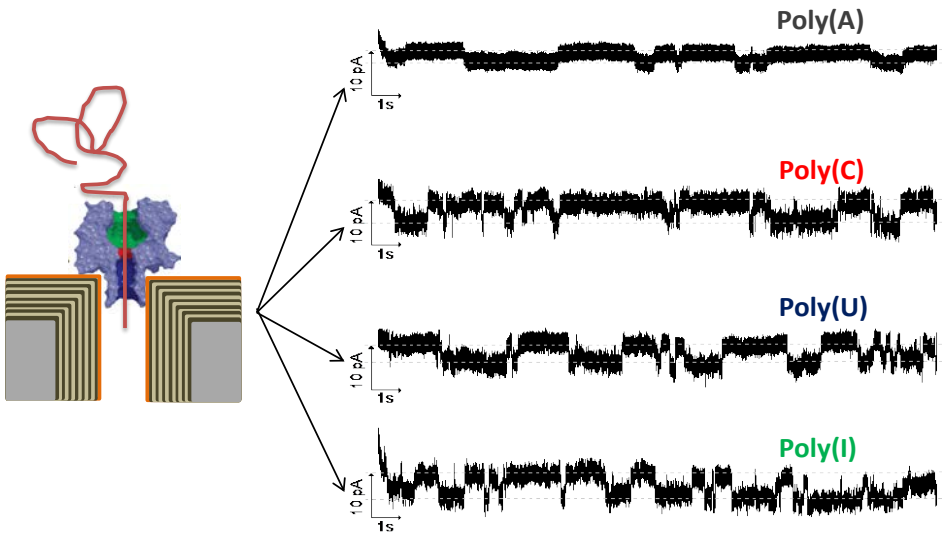

Figure 1: schematic representation of hybrid biological artificial nanopore based on α-hemolysin confinement and example of current trace induce by the polynucleotide translocation.