Electrical Characterization of the qNano for Particle Detection

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Background: What is a nanopore?

A nano-sized pore, usually in a membrane of some sort.

Types of Nanopores

Biological:

Alpha-Hemolysin pore: Alpha-Hemolysin is a bacterial toxin. The hemolysin monomers bond in a heptametric organization and inject themselves into an outer membrane. [1]

A heptametric assembly of an alpha-hemolysin in a bi-lipid layer. [1]

Solid-state:

Pore made up of three layers: 20nm silicon nitride, 200nm silicon dioxide, 500nm silicon nitride. [2]

Elastomeric (Stretchable):

Made from thermoplastic polyurethane, and can have varying lengths as the pore is stretched. [3]

Benefits of a Stretchable Nanopore

Cost efficient

Time efficient

Easy lab preparation

Varying Delta X allows for a range of capture rates for different sized particles

Goals

Distribution graphs

Characterizing the pore

Pore geometry (imaging)

Optimal voltage for capture

Optimal pore size (Delta X) for particle capture

Minimizing noise

Ultimate Goal: Virus Detection

Virus range in size from 10nm – 300nm

What is an event?

An event is also known as a translocation

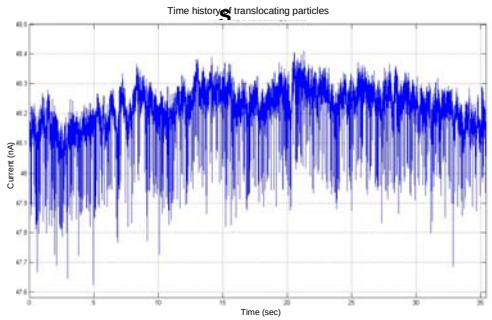
Recognized by

Change in current

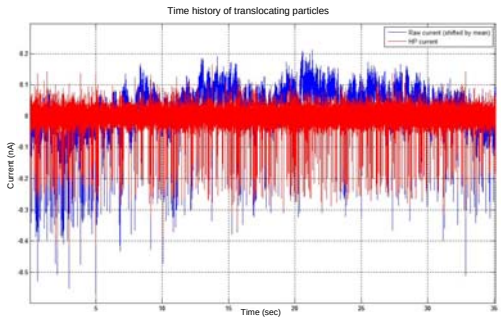
Change in amplitude

Also the deflection in the graphs

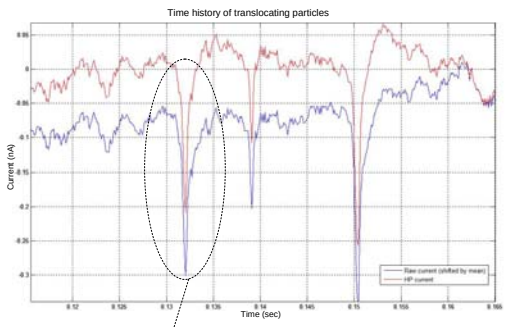
Result



Raw capture data- each deflection is an event.



High Pass Filter applied to the raw current.



An Event is characterized by the change in current and amplitude.

The Instrument: qNano

The instrument: qNano. [4]

Set-Up

Lower fluid-cell

Upper fluid-cell

Aperture

USB Interface (Live Data Trace)

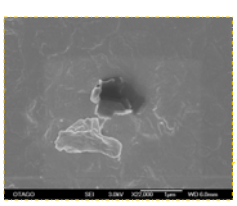
Materials

Buffer .1M KCl solution

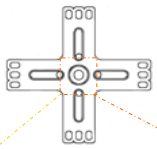
200nm particles / 1:100 concentration

Experiment Process

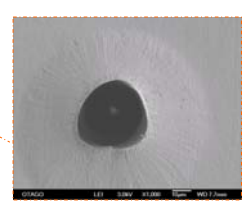
Lower fluid-cell is first filled with the buffer
Aperture primed and placed into the arms
Particles are added to the solution
Upper fluid-cell is set in place
Data Trace is turned on to capture events
Delta X (the pore is stretched is changed by turning the knob
Voltage also is a variant



Trans side (needle exit).



Aperture. [3]



Cis side (needle entry).

SEM (Scanning Electron Microscopy) image of the nanopore. [4]

Pore made with a Tungsten needle

Acknowledgements

[1] www.ks.uiuc.edu/Research/hemolysin

[2] Smeets, Ralph M. M.; Keyser, Ulrich F.; Krapf, Diego; Wu, Meng-Yue; Dekker, Nynke H.; Dekker, Cees 2006 *Nano Letters*

[3] Sowerby, Stephen J.; Broom, Murray F.; Petersen, George B. 2006 *Elsevier*

[4] www.izon.com

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