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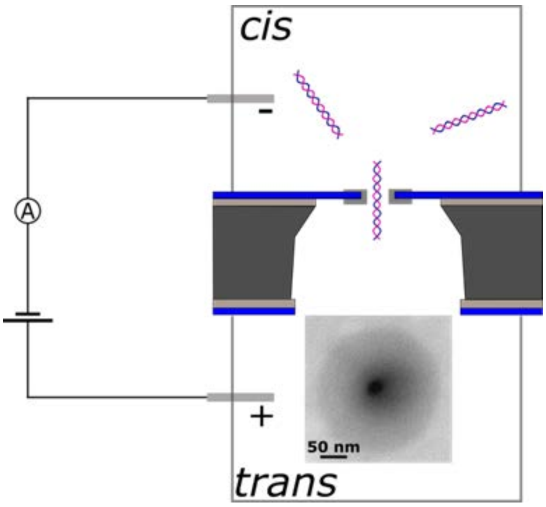
Title: Single molecule detection via solid state carbon nanopore

Author (s) Name: Shuangshuang Zeng, Chenyu Wen, Shi-Li Zhang, Zhen Zhang
Solid-State Electronics, The Ångström Laboratory, Uppsala University, Sweden

Abstract

Single molecule detection is of vital importance for fundamental biotechnology research and practical applications. Among the numerous single molecule detection techniques, solid-state nanopores have been developed as single molecule sensors for the investigation of unlabeled biopolymers such as DNA, RNA and protein owing to their robustness, pore size controllability and tunability of physical/chemical properties. The most commonly used method today to form ultra-small nanopores relies on using focused high energy electron beams on a transmission electron microscope (TEM). However, the sophisticated operation of TEM, high cost and low throughput limit its extensive applications. In this work, we start with electron beam lithography combined with reactive ion etching to massively prefabricate nanopores with relatively large size in free-standing silicon nitride membranes. Then, electron beam irradiation is used to deposit carbon with a conventional scanning electron microscope so as to reduce the size of prefabricated pores. This process leads to the controllable formation of solid-state carbon nanopores sub-30 nm in diameter. We subsequently use the carbon nanopores to study translocation of λ-DNA as a demonstration of the capability of such carbon nanopores. By tuning bias voltage, the translocation events show regular changes in amplitude, dwell time and appearance frequency. With this advanced nanopore platform, detection of single DNA molecules is achieved with a high signal-to-noise ratio of ~6.

Figures if any (BW/Color):



Schematic of the experimental system for detecting single DNA molecule with a nanopore. The inset shows a scanning electron micrograph of a 30 nm carbon nanopore.

Recent Publications

1. **Wen, C., Zhang, Z., & Zhang, S. L. (2017). Physical Model for Rapid and Accurate Determination of Nanopore Size via Conductance Measurement. *ACS sensors*, *2*(10), 1523-1530.**

2. **Wen, C., Zeng, S., Arstila, K., Sajavaara, T., Zhu, Y., Zhang, Z., & Zhang, S. L. (2017). Generalized Noise Study of Solid-State Nanopores at Low Frequencies. *ACS sensors*, *2*(2), 300-307.**
3. **Wen, C., Zeng, S., Zhang, Z., Hjort, K., Scheicher, R., & Zhang, S. L. (2016). On nanopore DNA sequencing by signal and noise analysis of ionic current. *Nanotechnology*, *27*(21), 215502.**

Biography

Shuangshuang Zeng is in his 3rd year of his PhD studies at Uppsala University in Sweden. He obtained his bachelor degree in material physics at University of Science and Technology of China. Currently, his research project concerns a novel electronic device based on solid-state nanopore for DNA sequencing. He has been mainly focused on solid-state nanopore fabrication using different techniques such as direct focused ion beam (FIB) milling and electron beam lithography (EBL) combined with reactive ion etching (RIE). He has expertise in micro and nano fabrication as well as thin film characterization.

Chenyu Wen received the B.S. degree in electronic science and technology form Southeast University, Nanjing, China, in 2012. He is currently a Ph.D. candidate at the department of Engineering Science, Uppsala University, Sweden. His research interests include nanopore sensors, electrochemical sensors, bio-sensors and flexible electronics.

Presenting author details

Full name: Shuangshuang Zeng
Contact number: +46708393163
Email id: shuangshuang.zeng@angstrom.uu.se
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