Characterization of single nanoparticle shape using solid state nanopore 阪大産研¹ °(M1)梁 逸偉¹, 筒井 真楠¹, 谷口 正輝¹ ISIR, Osaka Univ.¹,°Iat Wai Leong¹, Makusu Tsutsui¹, Masateru Taniguchi¹ E-mail: leong.iat.wai32@sanken.osaka-u.ac.jp

Nanoparticles have many useful properties that can be utilized in various applications. Thus, there is an urgent demand for setting up a standard method to evaluate, detect and characterize a single nanoparticle. Solid-state nanopore has found a wide range of uses as a unique sensor for label-free single molecule analyses including DNA, proteins and polymers due to its good stability, high sensitivity and simple mechanism. Recently, this technology also became feasible for detecting viruses and nanoparticles¹. However, It still lacks fundamental understanding of the ion transport in nanoparticle-occluded nanopores to know on what extent we can obtain the properties of the particulate matters from the ionic current measurements².

To explore the potential of nanopore sensing for measuring nanoparticles' physical characteristics, therefore, we systematically investigated how particle shape is reflected in the ionic current pulse signal patterns. For this, we employed synthetic nanoparticles having similar size but different shapes, such as spherical, cubic, or conical motifs. These particles were measured with nanopores of various diameter in 50 nm-thick Si_3N_4 membranes in 0.4 x PBS under 0.1 V. The obtained resistive pulses suggestive of single-nanoparticle translocation through the nanopores were then compared to results of finite element simulations of the cross-pore ionic current using COMSOL 5.4. Figure 1 shows a case of 168 nm-sized nanocube translocating through a 300 nm-sized nanopore demonstrating simple pulse-like ionic current blockade profile. In the presentation, other experimental and theoretical results will be presented and the spatial resolution of the nanopore sensor approach for analyzing single-particle structures will be discussed.



Fig.1 Finite-element simulation of a nanoparticles with a solid state nanopore.(a) Electric potential profile with voltage bias of 0.1V (b) Simulated ionic current generated by passing a 168 nm side length nanocube through a 300 nm diameter nanopore. References

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