Research Activity Report **2013.10.31**

Research title		Analysis of Relationship between Lipid Environment and Protein Nanopore Properties -Toward Creation of Blood Cell Model with Various Membrane Strength-
Visiting researcher	**Name**	Noriko Tomita
	Affiliation	Institute of Fluid Science, Tohoku University
	Title	Research Fellow of the Japan Society for the Promotion (RPD)
Visiting institution		Department of Physics, Syracuse University, NY, USA
Visiting period		March 2012 - March 2013
Host researcher	**Name**	Liviu Movileanu
	Affiliation	Department of Physics, Syracuse University
	Title	Associate Professor

Summary of Collaborative Research Activities

1. Introduction

As developing medical devices for circulatory diseases, red blood cell (RBC) model to evaluate dynamical and biological response of the cell against medical devices has been imperative. Pore-forming proteins distributed in a wide variety of organisms are known to attack mammalian RBC by forming nanopore on the membrane, and has potential to control membrane dynamics.

Here we show the physical and structural features of nanopores on different kind of lipid bilayer, and assesse the possibilities of development in RBC model possessing various membrane strengths with a variety of combination of lipid component and nanopore.

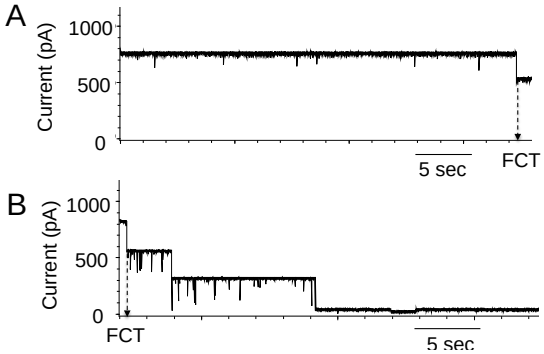

Fig. 1: Stepwise current transition of the E. coli FhuA ΔC/Δ4L nanopore in lipid bilayer. (A) FhuA ΔC/Δ4L nanopore reconstituted on cylindrical lipid bilayer. (B) FhuA ΔC/Δ4L nanopore formed on conical lipid bilayer. FCT means the first current transition time to lower-conductance open-state.

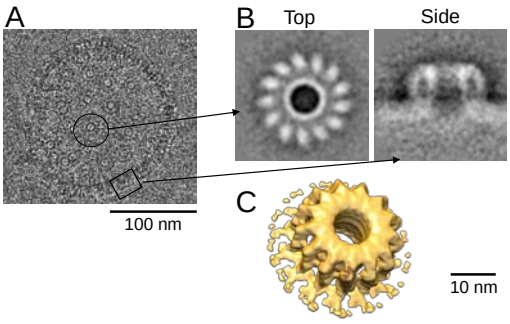

Fig. 2: Three-dimensional construction of mushroom pore-forming protein, Ply nanopore, by cryo-TEM. (A) Cryo image of Ply wheel-like pore reconstituted on liposome. (B) Averaged side and top views. (C) 3-D image of the wheel-like structure

2. Concluding remarks

Our results revealed individual pore-forming protein has different feature on each lipid environment. By incorporating nanopores into lipid bilayers with a variety of combination of lipid-nanopore, we would obtain diverse membrane systems with different dynamical properties. The theory can be applied directly to create RBC model with various membrane strengths by using artificial lipid vesicle incorporated nanopore.

Publications

1) Journal or conference papers with full paper review

[1] **Noriko Tomita**, Yoshiyuki Kamio and Makoto Ohta: Membrane-damaging activity against various phospholipid liposomes by gamma-hemolysin, staphylococcal two-component pore-forming cytolysin, *J. Biomech. Sci. Engineer.*, Vol. 7, No. 3 (2012), pp.292-304.

[2] **Noriko Tomita**, Mohammad M. Mohammad, David J. Niedzwiecki, Makoto Ohta, Liviu Movileanu, "Does the lipid environment impact the open-state conductance of an engineered β-barrel protein nanopore, *Biochim. Biophys. Acta Biomembranes*, Vol. 1828 (2013), pp.1057-1065.

Others: 2 papers to be submitted.

2) Conference papers or presentation without full paper review

[1] **Noriko Tomita,** Liviu Movileanu and Makoto Ohta: Electrophysiological Properties of Bacterial Membrane Channel Proteins Depending on Lipid Component and Bilayer Stability, *Ninth International Conference on Flow Dynamics*, Syracuse, USA (Sendai-Syracuse teleconference), (2012), pp.432-433. ***Invited***

[2] **Noriko Tomita**, Liviu Movileanu and Makoto Ohta: Electrophysiological properties of engineered FhuA ΔC/Δ4L protein nanopore affected by lipid bilayer environment, *The EMBO meeting 2013*, Amsterdam, Netherlands, (2013), pp.235-236.

Others: 4 invited lectures and 3 presentations in conferences.

3) Patent, award, press release etc.

[1] SU Physics News-September 2012, Presentation by Research Faculty, Posdoc and Student, Syracuse University, The College of Arts and Science, Department of Physics, Mohammad Mohammad: (Research Assistant Professor) and **Noriko Tomita** (Visiting Postdoc): invited videoconference talks at the International Conference of Fluid Dynamics 2012 (ICFD2012). **Noriko** chaired a session titled "Membrane Micro Channel for Health Care," during which the two talks were given, Sendai, Japan (September 19-21 2012).

Others: 2 articles on web-sites and 2 articles in news papers