Single molecule analysis of membrane protein activities

膜タンパク質の１分子計測

Univ. Tokyo [1], PRESTO, JST [2], PRIME, AMED[3] °Rikiya Watanabe[1,2,3]

東大・工 [1], JST・さきがけ [2], AMED・PRIME[3] ○渡邉力也 [1,2,3]

E-mail: wrikiya@nojilab.t.u-tokyo.ac.jp

The maintenance of an appropriate intracellular environment is a constant challenge for all living organisms, from prokaryotes to multicellular eukaryotes. Intracellular homeostasis is maintained by membrane proteins, e.g., membrane transporter, transporting various compounds such as ions, sugars, amino acids, and drugs across the cell membrane. Therefore, the analysis of transmembrane transport is crucial to understanding cell physiology as well as for exploring the bioavailability of drugs. Although extensive studies have performed to elucidate the mechanism of membrane transport, quantitatively and reproducibly measuring the transport in a high throughput format has remained difficult due to the complexity of processes involved in membrane formation. Here, we address this issue by developing a novel artificial cell-membrane microsystem (ALBiC) that forms sub-million femtoliter reaction chambers, each sealed with an artificial cell-membrane; i.e., phospholipid bilayer, with an efficiency of over 90 %. Due to the infinitesimal volume of these chambers, ALBiC can enhance the detection sensitivity by a factor of 10^6, demonstrating the single-molecule analysis of membrane transport in a high throughput manner. Moreover, we have recently demonstrated some physiological membrane aspects on ALBiC, such as asymmetric transbilayer phospholipid distribution, and modulation of membrane potential across lipid bilayers. Thus, our new platform, ALBiC, holds promise for understanding the mechanism of membrane transport under semi-physiologic conditions as well as for further analytical and pharmacological applications.