Molecular Physiology Laboratory（2020）
Chief Scientist: Rikiya Watanabe (Ph.D.)

(0) Research field

CPR Subcommittee: Biology

Keywords: membrane protein, artificial cell membrane, artificial cell, bioMEMS, digital biology

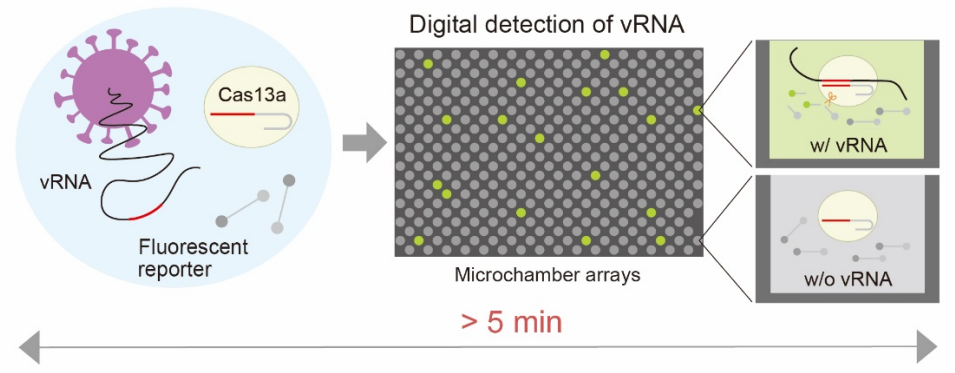
(1) Long-term goal of laboratory and research background

Our study aims to understand cellular functions using a bottom-up approach from the single molecule level. To achieve this, we are attempting to elucidate the mechanism by which individual biomolecules or their networks function in a precise manner, by developing novel single-molecule techniques using multidisciplinary approaches, including biophysics, bioMEMS, and chemical biology. In addition, we are developing a methodology to investigate correlations between genetic mutations, dysfunctions, and diseases with single molecule sensitivity, which would provide new insights for biological as well as pharmaceutical studies.

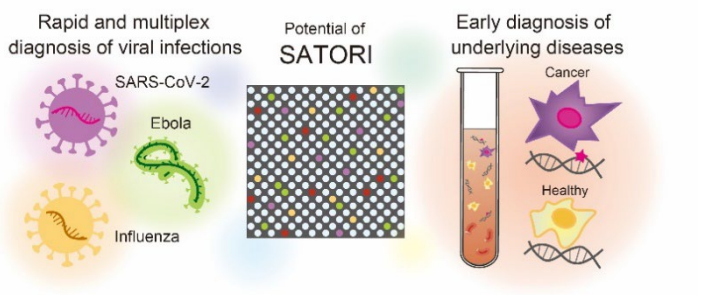
(2) Current research activities (FY2020) and plan (until Mar. 2025)

Development of amplification-free rapid detection method of SARS-CoV-2

Accurate and rapid nucleic-acid detection methods can contribute to early cancer diagnostics and virus pandemic prevention 1,2. Currently, the demand is urgently increasing, since the novel coronavirus SARS-CoV-2 has caused over 117 million infections and 2.6 million deaths world-wide (as of 8th Mar 2021). Reverse transcription quantitative PCR (RT-qPCR) is widely used as a "gold standard" method for SARS-CoV-2 diagnosis, however, the amplification process of RT-PCR requires the detection time over several tens of minutes, and could cause false-negative or -positive results due to amplification errors. To overcome these challenges, we combined the CRISPR-Cas13-based nucleic-acid detection system and our microchamber technology to develop a platform that enables accurate and rapid detection of single-stranded RNA (ssRNA) at a single-molecule level, termed SATORI (CRISPR-based amplification-free digital RNA detection) (***Commun. Biol.*** 2021). SATORI enabled rapid and sensitive detection of whole genomic RNA from SARS-CoV-2, thereby highlighting the potential of SATORI as a powerful new class of rapid and robust viral diagnostics.



In addition to SARS-CoV-2, SATORI could also be used to detect a biomarker in other diseases such as cancer, and we are currently exploring new uses in addition to SARS-CoV-2.



(3) Members

(Chief Scientist)
Rikiya Watanabe

(Research Scientist)
Jun Ando, Hajime Shinoda

(Special Postdoctoral Researcher)
Yoshiaki Kinoshita

(Technical Staff)
Asami Makino, Chiharu Takahashi

(4) Representative research achievements

1. "Amplification-free RNA detection with CRISPR-Cas13", Shinoda, H., Taguchi, Y., Nakagawa, R., Makino, A., Okazaki, S., Nakano, M., Muramoto, Y., Takahashi, C., Takahashi, I., Ando, J., Noda, T., *Nureki, O., *Nishimasu, H., & *Watanabe, R., ***Commun. Biol.***, 4, 476 (2021)

2. "Monodisperse Liposomes with Femtoliter Volume Enable Quantitative Digital Bioassays of Membrane Transporters and Cell-Free Gene Expression" Soga, N., Ota, A., Nakajima, K., Watanabe, R., Ueno, H., & *Noji, H. ***ACS Nano***, 9, 11700-11711 (2020)

Laboratory Homepage
https://www.riken.jp/research/labs/chief/mol_physiol/index.html
http://nanobio.riken.jp/index.html