BSJ 2019 “Single-cell PRESTO” session

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What is “Single-cell PRESTO” doing?—This was the title of the symposium we organized at the 57th Biophysical Society of Japan, Miyazaki Meeting. We challenged the audience to find their own answers to this question after the symposium. PRESTO (Precursory Research for Embryonic Science and Technology) is a research program supported by the Japan Science and Technology Agency (JST). In PRESTO programs, JST supports research projects that are expected to be conducted by individual researchers.

Researchers joining the “Single-cell PRESTO” group, including the authors of this article, had heterogeneous research backgrounds and interests with very diverse projects represented by many keywords such as imaging, fluorescent or microfabricated probes, gene expression and/or omics analysis, neuroscience, membrane, sequencing and quantification of nucleic acid molecules (Shiroguchi et al. 2012; Ogawa et al. 2017), development, heat-sensing (Hou et al. 2017) and manipulation (Marino et al. 2017), cell-measurement and manipulation, modeling, and glycans. However, we shared a single keyword, i.e., “single-cell studies.”

This symposium was a showcase of specific examples of single-cell studies by six members of the Single-cell PRESTO group. They presented the advances and significance of their own single-cell studies, new techniques they have developed, and challenges for new research fields.

The first speaker was Dr. Wataru Aoki from Kyoto University. He began with a general introduction about studies on *Caenorhabditis elegans* (*C. elegans*) by showing that individual cells can be tracked from the egg stage during the entire process of its development. However, it is still unclear how

behaviors are governed by the network of neuronal cells in *C. elegans*. He demonstrated that his newly developed method in which optogenetics and Brainbow technologies were combined could have higher throughput for the cellomics analyses of neural networks in *C. elegans* compared with that of widely used optogenetical approaches (Aoki et al. 2018).

Dr. Keisuke Isobe from the RIKEN Center for Advanced Photonics talked about his ways of improving the spatial resolution in fluorescence optical microscopy in deep tissues for up to sub-cellular resolution. One of his methods, interferometric temporal focusing microscopy, combines structured illumination microscopy and three-photon excitation fluorescence microscopy, so that both spatial resolution and imaging depth are improved at the same time (Toda et al. 2018).

Our third speaker, Dr. Mako Kamiya from the University of Tokyo, is one of the world-leading chemists developing fluorescent molecules for imaging in biological and medical uses. Among a variety of their synthesized probes, she mainly introduced two new molecules. These molecules target lacZ positive cells and make the cells fluorescent (Ito et al. 2018) or able to be ablated (Chiba et al. 2019) with single-cell resolution. She demonstrated that their probes are applicable from in vitro cell cultures to in vivo models.

Dr. Satoru Okuda from Kanazawa University introduced his recent three-dimensional vertex model (Okuda et al. 2018). He successfully demonstrated that their single-cell-integrated modeling of multi-cellular 3D dynamics could reproduce the formation of optic cup organoids formed by pluripotent stem cells. He combined modeling with mechanical stimulations and argued that mechanical force plays a key role in robust organogenesis.

The second-to-last speaker, Dr. Yuichi Taniguchi from the RIKEN Center for Biosystems Dynamics Research, introduced his recent achievements in two different projects, the Hi-CO (Hi-C with nucleosome orientation) method and PISA microscopy. The Hi-CO method is a combined technology of biological and computational analyses, with which the structure of genomic DNA was determined at a sub-nucleosome level (Ohno et al. 2019). PISA microscopy performs single-molecule fluorescence imaging in a wide field of view with

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less background noise by using an optically illuminated thin plane that is angled to the optical axis of the specimen in a flow cell (Taniguchi and Nishimura 2014).

Finally, Dr. Satoshi Yamaguchi from the University of Tokyo demonstrated how well his biomaterials could change their affinities to cells by light stimulations (Izuta et al. 2019). Modified patterns of the material could produce complex distributions of both adherent and floating cells using appropriate timing and spatial patterns of light stimulations.

During the symposium, audiences were entering and exiting after each lectures. Due to the mixture of biological subjects and technical expertise, some audience members could find more interest in some lectures, while the same lectures could not fit so well with the interests of other audience members. This behavior of the audience perhaps proved the variety within Single-cell PRESTO, a melting pot of researchers.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by the authors.

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