Institute for Basic Science

IBS Center for Molecular Spectroscopy and Dynamics

COLLOQUIUM

■ SPEAKER

Dr. Hee-Sun Han (David A. Weitz Lab, Department of Physics/Applied Physics, Harvard University)

■ TITLE

Understanding living tissues at their cellular level: new platforms for imaging and sequencing single cells

■ ABSTRACT

Development of new physical and chemical tools has been the driving force of major advances in life sciences. In particular, new imaging and sequencing tools have allowed researchers to analyze cellular characteristics at the single cell resolution. Single cell studies have reinforced the importance of analyzing cellular characteristic at the single cell resolution by revealing the heterogeneity existing even within small cell populations, rare cells playing a key role in determining the fate of the entire tissue, and stochastic processes in cell fate decisions. As a first step to study how the characteristics of single cells contribute to the function of the tissues, the organs, and ultimately the organism, we developed new platforms enabling probing of the microenvironments of single endogenous cells in live animals and characterization of the genomic or epigenomic profile of single cells and viruses in a high throughput manner. These new tools can be combined to isolate cells showing specific in vivo characteristics and analyze their genomic or transcriptomic profiles at the single cell resolution. This approach is expected to provide unique insight into prediction of the cell fate, thereby lead researchers to be a step closer to one of the ultimate goals of life sciences: understanding living tissues at their cellular level.

To image single endogenous cells in live animals and probe their microenvironments, newly developed quantum dot (QD)-antibody conjugates are used as fluorescent probes in multiphoton intravital microscopy. The new technique allowed us to (i) image endogenous hematopoietic stem and progenitor (HSPC) cells, (ii) analyze the location of the niche and (iii) directly measure their oxygenation. By enabling imaging and tracking of single endogenous cells in live animals, our work leads to new studies on single cell movements, cell-to-cell interactions and the micro-environments of single cells in their native states.

Fundamental understanding of cellular behaviors requires molecular profiling of the cells. For high throughput analysis of the genetic or transcriptomic profile of single cells or viruses, we developed microfluidic platforms enabling isolation, detection, purification and amplification of single target cells from a heterogeneous sample. Using this platform, we purified the target viral species from a complex virus mixture and assembled their complete genome sequence. Extending this work, we are currently developing new platforms for high-throughput genome sequencing of single viruses or cells. The new platforms will be used to identify the genome sequence of novel viruses present in environmental samples and also be used for whole genome haplotyping of eukaryotic cells.

■ DATE AND VENUE

August 03, 2016 (Wednesday, 4:00-5:00 p.m.)
Seminar room 116, R&D Center