Realization of Common Platform Technology, Facilities, and Equipment that creates Innovative Knowledge and Products

Subnanometer-Scale Measurement and Analysis System for Three-dimensional Fluctuating Structures

Project Leader : Takeshi FUKUMA, Director,
Nano Life Science Institute (WPI-NanoLSI), Kanazawa University

R&D Team : Aalto University, Osaka University, University of Tokyo, RIKEN,
Hitachi High-Tech Science Corporation

Summary :

We will develop a method for directly imaging three-dimensional (3D) distribution of mobile liquid molecules or flexible molecular chains in liquid. In addition, we will develop a method for deducing the atomic-scale real-space model representing the target 3D structure.

[Technical Development] We previously developed 3D atomic force microscopy (3D-AFM) that can visualize subnanoscale 3D distribution of water and relatively short molecular chains. In this study, we will enhance the speed and capacity of 3D-AFM and employ a carbon nanotube probe for visualizing various 3D fluctuating structures with a relatively large thickness (> 2 nm). In the meantime, we will also develop the data analysis method. In the method, we construct an atomistic 3D model of the target 3D structure and simulate a 3D-AFM image. By repeating the comparison between the images obtained by the experiment and simulation, we will improve the similarity between them and eventually obtain the best guess of the atomistic real-space model of the target 3D structure.

[Applications] We will apply the developed technique for the studies in both materials and life sciences. As a life science study, we will visualize the 3D chromatin structures inside a chromosome and investigate their correlation with the gene expression mechanism. As a materials science study, we will visualize 3D distribution of ionic liquids in an electric double layer transistor for understanding the correlation with the mechanism of its superconductivity.