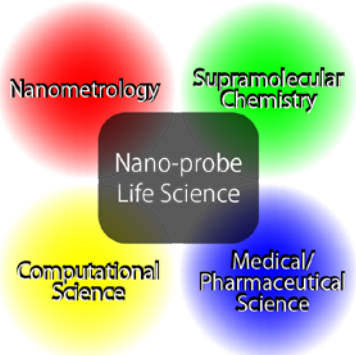
Kanazawa University Nano Life Science Institute (NanoLSI)

Director: Takeshi Fukuma

Prof. Fukuma developed the world's first liquid-environment frequency modulation atomic force microscope (FM-AFM) with true atomic resolution, making it possible to observe the surface structures of biomolecules, and three-dimensional distributions of hydration and flexible surface structures with subnanometer resolution at solid-liquid interfaces. Based on these advanced nanoprobe technologies, we here plan to develop "nanoendoscopic techniques" that allow for the imaging, analysis, and manipulation of nanodynamics in live cells. Using the developed techniques, we aim to achieve nano-level understandings of various life phenomena.

Research Objectives

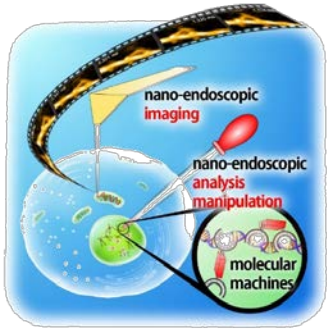


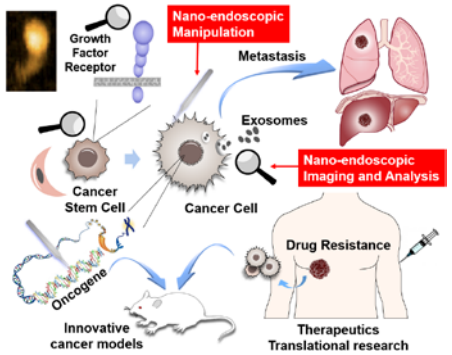
We aim to combine the world's most advanced technologies in bio-scanning probe microscopy (SPM) and supramolecular chemistry to develop "nanoendoscopic techniques" that allow for the direct imaging, analysis, and manipulation of the nanodynamics of proteins, metabolites, and nucleic acids on the surface of and inside the cell. Using the developed techniques together with multi-scale simulation, we aim to achieve nano-level understanding of the mechanisms underlying basic cellular functions and their cancer-specific abnormalities by comparing normal and cancer cells. Based on the technologies and knowledge acquired through this process, we aim to establish a new research field termed "nanoprobe life science," with the broad goal of achieving nano-level understandings of various life phenomena using nanoprobe technologies.

The Center's Specialty

- To ensure sustainability of the center, the budget and human resources of an existing organization will be utilized, which was formed with the goal of creating new, interdisciplinary fields of study.
- To reduce administrative work to a minimum and cultivate a research-focused environment, the university's unique "research professor system" will be applied to all Principal Investigators .
- To nurture young researchers with interdisciplinary, comprehensive, and international research capacities, specially selected educational programs will be developed.

Outline of Research





1. To enable intra/extracellular imaging at the nano-level, we will integrate Kanazawa University's state-of-the-art bio-SPM technologies, such as high-speed and three-dimensional atomic force microscopy (AFM) and high-speed scanning ion-conductance microscopy (SICM).
2. To enable the analysis and manipulation of intra/extracellular nanoscale dynamics, we will combine our expertise in bio-SPM and supramolecular chemistry.
3. Using our advanced nanoprobe technologies and simulation techniques, we aim to understand the nano-level mechanisms of basic cellular functions and their cancer-specific abnormalities.

Satellites

Europe: Imperial College London, London, UK

North America: The University of British Columbia, Vancouver, Canada

We will establish satellite research sites at these institutions, strengthen collaborative research efforts, and hold annual international symposia in Japan, Europe, or North America to improve the worldwide visibility of our center.