Into the nanorealm for a closer look at life

The NANO LIFE SCIENCE INSTITUTE (NanoLSI) at Kanazawa University is recruiting postdoctoral researchers for a place at the forefront of the nanobiosciences.

Boldly searching where no imaging tools have searched before: that is the vision of Takeshi Fukuma, the director of the Nano Life Science Institute (NanoLSI). Since its launch in October 2017, the institute has launched an exciting range of collaborations. "Our projects are directed towards leading the rapidly growing the emerging field of nanoprobe life science," says Fukuma.

Acclaimed for his work on nanoscale measurement technologies, Fukuma developed the first frequency-modulation atomic force microscopy (AFM) system that can be operated in liquid with a true atomic resolution in 2005. This achievement enabled the visualization of biological systems' surface structures at sub-nanometre resolution. And, in 2010, Fukuma led a group that developed a three-dimensional AFM technique that has transformed research of hydration and flexible surface structures at nanobiointerfaces.

The ultimate goal for scientists at NanoLSI is to achieve real-time nanoscale imaging of living cells and gain insights impossible to achieve with other technologies. These will revolutionize our understanding of cellular and molecular dynamics, and accelerate advances in biotechnology and medical applications.

"IT'S NOT EASY, BUT IT'S VERY EXCITING"

NanoLSI is a hub of pioneers in the bioimaging field, including the inventor of high-speed AFM, Toshio Ando, and others who have helped establish Kanazawa University as the go-to centre for bio-scanning probe microscopy over the last decade.

Research at NanoLSI focuses on four main areas: nanometrology, life science, supramolecular chemistry and computational science. The latter is a field with "plenty of room to grow," according to Fukuma. "As our AFM research generates an enormous number of images, automated analysis based on machine learning is crucial to allow for enabling us to compare simulations with experimental data."

"NanoLSI is designed for interdisciplinary research," he says. "The institute is geared towards young scientists who want to explore the forefront of emerging fields."

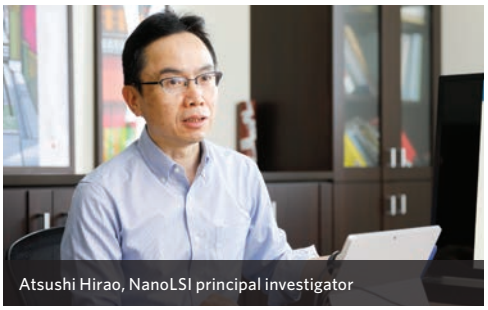
Driving advances in human health

Atsushi Hirao, director general of the Kanazawa University Cancer Research Institute, who leads the Life Science Group at NanoLSI, says that the new institute provides valuable learning opportunities for transdisciplinary research. "It's not easy, but it's very exciting," he says. "Biologists and chemists are working together to approach cancer research in entirely new ways."

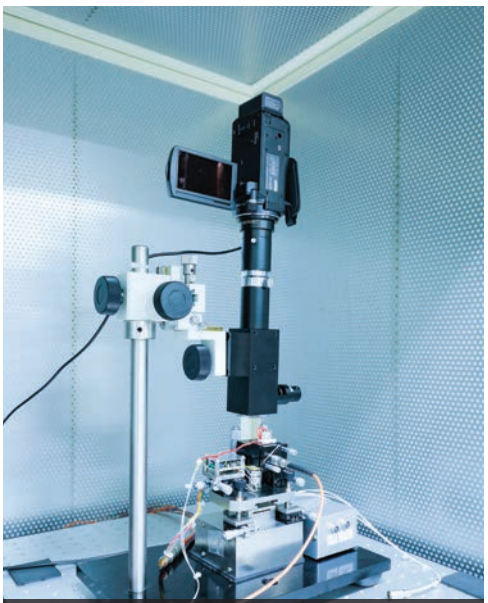
Early in 2018, Hirao's research on cancer progression took a new turn through a chance meeting with Tomoki Ogoshi, a Kanazawa University-

Takeshi Fukuma, NanoLSI director

Tomoki Ogoshi, NanoLSI principal investigator



Atsushi Hirao, NanoLSI principal investigator



Atomic force microscope that can image atomic-scale dynamics in liquids

based supramolecular chemist acclaimed for his work on macrocycles. Macrocyclic compounds are currently of intense research interest due to their molecular recognition capability.

"I showed him a nutrient-related metabolite that could be a good biomarker for tumour development," Hirao recalls. "I was immediately impressed by his interest in the structure of the metabolite. Now, working together at NanoLSI, our aim is to develop a macrocyclic sensor that binds specifically to this metabolite." Such developments could lead to unprecedented precision in designing new therapeutic approaches and diagnostic tools.

"As a chemist, my collaborations at NanoLSI have enabled me to explore new applications for the supramolecular field," says Ogoshi. As well as breakthroughs in cancer research, macrocyclic compounds could play a major role in many other aspects of biomedicine and materials science.

A growing international network

NanoLSI is opening its doors to the wider scientific community in several ways. It has a unique, open facility that can be used by AFM groups as well as external collaborators. The institute has launched a fellowship programme, which is open to molecular, cellular and structural biologists from around the world. The scheme sees invited researchers participate in collaborative research and other academic activities at NanoLSI for a month or longer, thus expanding the institute's collaborative network.

In addition, NanoLSI is also engaged in educational outreach through the Bio-AFM Summer School, a popular initiative that has been running at Kanazawa University since 2012. This week-long intensive programme enables students from Japan and overseas to get rare, hands-on experience operating a range of AFMs and scanning ion conductance microscopes and prepare their own samples under expert guidance.

In February 2018, the inaugural NanoLSI International Symposium was held in Tokyo, and there are plans for further meetings to be held in London in late 2018, and in Vancouver in 2019. These international exchanges extend partnerships NanoLSI is building through its two satellite research centres at Imperial College London, and the University of British Columbia in Vancouver.

Selected as a World Premier International (WPI) Research Center by the Japanese government, NanoLSI is supported by annual funding of ¥700 million (approximately US$6.3 million) until 2027.

"By combining the world's most advanced bio-scanning probe microscopy techniques and supramolecular chemistry, we're already developing new nanoprobe technologies," says Fukuma. These technologies allow scientists to go beyond the surface of cells and look deep into their interiors — at metabolites, nucleic acids and other building blocks of life. NanoLSI welcomes enquiries from all those who are interested in delving into these unknown nanorealms. ■

NanoLSI
WPI KANAZAWA UNIVERSITY
Kakuma-machi, Kanazawa
920-1192, Japan
https://nanolsi.kanazawa-u.ac.jp/en/
nanolsi-office@adm.kanazawa-u.ac.jp