



PROBING LIFE AT THE NANOSCALE

Selected as a World Premier International Research Center by the Japanese government in 2017, the Nano Life Science Institute at Kanazawa University has **BIG PLANS TO UNCOVER CELLULAR DYNAMICS** through the development of nanoprobe technologies.

How cells function at the nanolevel remains one of the great unknowns. Imaging techniques currently available, such as fluorescence microscopy, have limitations in terms of resolution and quality that hinder deeper exploration. Japan's Nano Life Science Institute (NanoLSI) is dedicated to advancing this frontier by building on pioneering technologies developed at Kanazawa University and by bringing together a 'dream team' of experts in nanotechnology and the life sciences.

"Our goal is to bridge our expertise in nanoscience with the live cell imaging field," says Takeshi Fukuma, director of NanoLSI and a specialist in nanoscale measurement technologies.

In contrast to static, 'snapshot' views of cells, successful visualisation of nanoscale dynamics — the real-time workings of proteins, metabolites and other molecular assemblies — is widely anticipated to lead to breakthroughs in both fundamental biology and medical science.

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Many aspects of human development, disease and ageing are just beginning to be investigated from a nanoscale perspective. "Until now, our knowledge of nanoscience has mostly been applied to

the fields of materials science and energy science, with great success," Fukuma says. "We are now extending our capability to explore a wider range of fundamental biological phenomena at the nanoscale."

Unique strengths
Established in October 2017, NanoLSI has been designated by Japan's Ministry of Education, Culture, Sports, Science and Technology as a World Premier International (WPI) Research Center. It is the tenth centre to be selected since the start of the WPI programme in 2007 in recognition of its outstanding potential to become an international hub for innovative, interdisciplinary research. NanoLSI will receive funding of ¥700 million (approximately

US\$6.2 million) per year up to 2027.

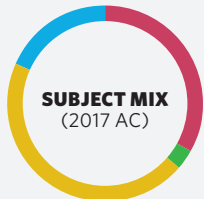
Fukuma says: "The launch of this WPI project is a tremendous honour for Kanazawa University, and with it we are able to realize our vision of combining two of our key strengths. One is our expertise in bio-scanning probe microscopy (bio-SPM), and the other is the university's long history of cancer research."

World-leading technologies developed at Kanazawa University's Bio-Atomic Force Microscopy (Bio-AFM) Frontier Research Center will be used to full effect. Now working at NanoLSI are the researchers who invented and developed techniques such as high-speed AFM, 3D AFM and state-of-the-art bio-SPM.

SOURCE: NATURE INDEX

EXPANDING HORIZONS

KANAZAWA UNIVERSITY is committed to promoting collaborations at home and abroad.



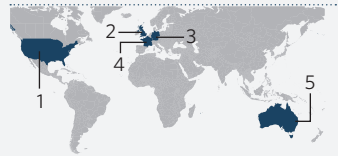
Chemistry	34.9%
Earth & Environmental Sciences	3.2%
Life Sciences	41.3%
Physical Sciences	20.6%

NUMBER OF DOMESTIC AND INTERNATIONAL COLLABORATING INSTITUTIONS (2012-2017)

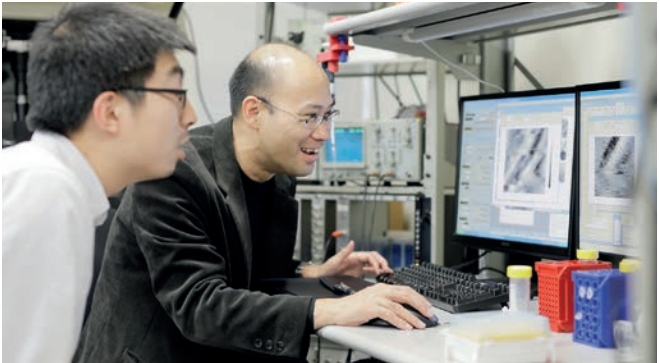
	Domestic	International
2012	47	38
2013	67	58
2014	43	52
2015	116	247
2016	88	338
2017	78	417

TOP 5 COLLABORATING COUNTRIES BY NUMBER OF COLLABORATING INSTITUTIONS (2012-2017)

1. United States	156
2. United Kingdom	54
3. Germany	41
4. France	37
5. Australia	30



Kanazawa University (KU) is cultivating new technologies in cancer research and other areas (far left). Takeshi Fukuma, director of the Nano Life Science Institute (NanoLSI), aims to fuse KU's strengths in nanoscience with live cell imaging (with colleague, top). Atsushi Hirao, director general of KU's Cancer Research Institute (with colleague, bottom left). The Innovation Center of the new NanoLSI (bottom right).



Although many had questioned the viability of investigating cancer using nanotechnology methods, says Fukuma, discussions between disparate research groups has enabled them to find common ground. "The idea is to compare nanoscale structures of normal cells and cancer cells, and identify cancer-specific abnormalities," he says.

For researchers at Kanazawa University's Cancer Research Institute (KU CRI), building new collaborations with nanotechnology and engineering teams through the WPI project is an unmissable opportunity.

"We aim to develop new technologies such as nanoendoscopy and expand the application of bio-AFM for cancer research," says Atsushi Hirao, director general of KU CRI. These technologies, he explains, will help improve spatial mapping of key biomolecules, such as metabolites, as nobody yet knows their exact distribution inside cancer cells.

Kunio Matsumoto, who focuses on the role of hepatocyte growth factor (HGF) in cancer progression at KU CRI, says: "We have been analysing the relationship between HGF and its receptor using high-speed AFM. This technology is simply amazing. We've already been able to uncover very fine, dynamic structures. In future, dynamic visualisation would reveal the mechanisms and functions of biomolecules in even finer detail."

The KU CRI is authorized as a Joint Usage Research Center by the Japanese government to promote collaboration among the cancer research community within Japan and internationally.

Through this collaborative approach, researchers at the KU CRI are now working with Yuri Korchev, professor of biophysics at Imperial College London, to study metabolites using scanning ion conductance microscopy (SICM) and scanning electrochemical microscopy (SECM). For

example, oncometabolites are currently in the spotlight as key molecules for understanding cancer cell behaviour and malignant progression. "Working with a supramolecular team here at Kanazawa University, we aim to achieve successful imaging of metabolites in living cells," says Hirao.

Getting involved

Based on existing partnerships with researchers overseas, NanoLSI will launch two satellite research centres at Imperial College London and the University of British Columbia in Vancouver, with the vision of further promoting interdisciplinary research and stimulating dialogue.

"When it comes to the nanoscale, the borders between disciplines begin to merge," says Fukuma. "There are no clear boundaries between physics and chemistry, for instance, so the challenge is to collaborate effectively across all of these fields. The four main fields we

are focusing on at NanoLSI are nanometrology, life sciences, supramolecular chemistry, and computer science."

Currently, 16 principal investigators are based at the institute, and there are plans to expand. "We are actively recruiting talented researchers at assistant professor level," says Fukuma.

The opening of NanoLSI was marked with a symposium at Tokyo's National Museum of Emerging Science and Innovation (Miraikan) from 21-22 February 2018. Coordinating with the satellite research centres in London and Vancouver, NanoLSI also plans to hold this event as an international symposium on a rotational basis in future. ■

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