

NIMS NOW 4

NATIONAL INSTITUTE FOR MATERIALS SCIENCE

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INTERNATIONAL

A close-up portrait of a young man with dark hair and a serious expression, looking directly at the camera. He is wearing a light-colored collared shirt. The background is blurred.

ICYYS

-International Center for Young Scientists-

Gateway to the World



ICYS

-International Center for Young Scientists-
Gateway to the World

The ICYS program offers talented young researchers who have earned their PhDs within 10 years, opportunities to engage in research using NIMS' first-class resources.

Recruitment for this program always receive more than 30 times as many applications from around the world. Admitted applicants receive full support so that they can completely dedicate themselves to the research of their choice side-by-side with their peers.

Many ICYS alumni have a common view of their experiences at the ICYS: the ICYS offered them an ideal research environment which enabled them to fully concentrate on their research.

What advantages of the ICYS program make it so attractive to young researchers? We interviewed current and former ICYS research fellows to find three features of the program.



* The International Center for Young Scientists (ICYS) attracts talented young researchers from around the world. ICYS research fellows receive two million yen in annual research funding for their independent research—a generous amount for a postdoctoral program. Each ICYS research fellow is mentored by two permanent researchers at NIMS and receives substantial administrative support, including research budget management and business trip arrangements. The initial three-year ICYS appointment may be extended for a maximum of two years (starting in April 2023; see the lower section of p. 15 for details). Those who complete the ICYS program receive preferential treatment if they choose to apply for a permanent research position at NIMS. Applications for the ICYS program are accepted twice a year.

“ICYS” is a career-building foundation

The International Center for Young Scientists (ICYS) offers young researchers an ideal research environment that enables them to fully concentrate on their independent research. Dr. Ryo Matsumoto and Dr. Jonathan Hill are both ICYS alumni who currently work as permanent researchers at NIMS. The two discussed the ICYS’ advantages.

The ICYS offers a high-quality environment that supports independent research

Matsumoto: I have been researching how applying pressure to materials can affect their structures and physical properties. I’m particularly interested in superconducting materials. Because the electrical resistance of superconductors can be reduced to zero and their magnetic flux can be completely removed, they can be used to create electric wires capable of carrying electricity without losing energy and magnets capable of generating extremely strong magnetic fields when large electric currents are passed through them. However, inducing superconductivity requires extremely cold conditions below transition temperatures. In my research, I have been trying to substantially raise the transition temperatures of superconductors by applying pressure to them.

Hill: Molecular synthesis has been my research focus since graduate school. I have a special interest in understanding the effect that a material’s molecular structure has on its optical, electrical and catalytic properties. After completing my Ph.D. in 1995, I came to Japan to work as a researcher at the Osaka National Research Institute (currently AIST Kansai). I then conducted postdoctoral research in Germany and the UK and participated in an extensive research project at the University of Tokyo. This is when one of the project members got a job at NIMS who subsequently told me about the ICYS program



and suggested that I apply. Because I had a Japanese wife, I wanted to continue working in Japan. I applied for the program and became an ICYS research fellow in 2004.

Matsumoto: As a college student, I learned of NIMS’ reputation as an ideal place for in-depth superconductor research. With the hope of becoming a NIMS researcher, I enrolled in the University of Tsukuba–NIMS Joint Graduate School. I learned about the ICYS during my graduate studies but I didn’t

think I would be eligible to apply for an ICYS research fellowship immediately after completing my Ph.D. I found that this was not the case at a scientific meeting. After I gave my presentation, another participant—who I later learned was an ICYS research fellow—commented that my research subject and accomplishments would be a good fit for the ICYS program. He seemed impressed by my research methodology. I had made a computational prediction and confirmed the results

experimentally. Discovery of new superconductors had traditionally been achieved experimentally. However, the computational prediction approach to finding new superconductors was being developed around the time that I was a graduate student, which is why I adopted it in my research. Encouraged by this researcher’s comments, I applied for the ICYS program as soon as I earned my Ph.D.

Hill: You joined the ICYS when you were much younger than I was. I joined it in my mid-thir-

Ryo Matsumoto × Jonathan Hill

(a former ICYS research fellow from 2020 to 2022)

(a former ICYS research fellow from 2004 to 2006)

the sense that he was able to put himself in a position to fully concentrate on the type of research he’s passionate about at a young age.

This is the major advantage of the ICYS program: participants are encouraged to choose their own independent research paths and their projects are properly funded. Before joining the ICYS, I had always conducted my research under the supervision of an advisor. Coming to the ICYS was a great move for me because I knew exactly what I wanted to do. I could also freely allocate my research budget according to my specific research needs and I had access to an array of cutting-edge lab equipment at NIMS. Another advantage is that the ICYS recruits excellent researchers from around the world. I gained valuable experience engaging in discussions with international researchers and teaming up with them on our research projects.

Matsumoto: As Dr. Hill just said, NIMS has a wealth of state-of-the-art lab equipment. However, when I was a graduate student, my access to this resource was limited. After I began doing independent research at the ICYS, I gained full access to NIMS’ equipment with financial support to pay for its use. This freedom benefited me the most. This financial support also paid for my use of equipment owned by other organizations. As I conducted part of my research outside the ICYS, I became acquainted with external researchers with different expertise, leading to the development of joint research projects. As far as I know, postdoctoral research programs that give participants this level of flexibility and independence in research are rare.

Supportive mentors and peers

Matsumoto: Unlike Dr. Hill, I only had limited research experience when I came to the ICYS, making it initially challenging for me to make and follow my own research plans. I managed to overcome this with the help of the ICYS mentor system. Two senior researchers with different expertise served as my mentors and their advice was very helpful and encouraging.

ties. I had a lot of training and experience going in. I had published in Science, a world-renowned journal, and conducted postdoctoral research at world-class laboratories. I also submitted a well-thought-out research proposal to the ICYS. All these efforts contributed to my acceptance to the ICYS program and my current position at NIMS.

By contrast, Dr. Matsumoto became an ICYS research fellow soon after completing his Ph.D. That’s a great accomplishment too, in

“ICYS” is a career-building foundation

Ryo Matsumoto × Jonathan Hill



Ryo Matsumoto

Researcher,
Nano Frontier Superconducting Materials Group,
International Center for Materials
Nanoarchitectonics (WPI-MANA)

Matsumoto completed the Production Systems Engineering program at the National Institute of Technology, Yonago College in 2015. He then studied in the Materials Science and Engineering program at the University of Tsukuba-NIMS Joint Graduate School and earned his Ph.D. in engineering in 2020. He became an ICYS research fellow in 2020 and assumed his current position at NIMS in 2022.



Matsumoto working in the lab when he was an ICYS research fellow. He assembled a diamond anvil cell in preparation for high-pressure experiments. Matsumoto said that the ICYS program enabled him to fully concentrate on his independent research for two years.

A common problem faced by young researchers—including myself—is that our research often deviates from our plans as we lose our comprehensive perspective. While working at the ICYS, I built my own experimental equipment. Although precise equipment is needed to conduct precise experiments, if you spend too much time and energy building equipment, you may end up compromising other aspects of your experiments, leading to failure. My mentors helped me achieve a better balance between these different aspects of my experiments. Without their advice, I would have been less productive during my two-year ICYS term*.

Hill: The mentor system is also indispensable for ICYS research fellows with previous postdoctoral research experience. My mentor had a clear vision for the future and always gave me positive advice. Our similarity in age enabled us to engage in frank discussions as peers. Conducting independent research without help from others would be difficult even for those with previous postdoctoral research experience.

I'm now serving as a mentor for an ICYS research fellow. I recently recommended that my mentee participate in a nanocar race—an event in which participants compete in moving nanosized molecules—to further improve his already excellent molecular synthesis skills. I was very pleased that he received very high scores. Although it's important for young researchers to learn from senior researchers, they also need to put what they learn into practice. Similarly, ICYS research

fellows need to be able to carry out research independently instead of merely following their mentors' advice.

Matsumoto: Interacting with my ICYS peers was also important for me. I shared a common room with many other ICYS research fellows with different specialties. I sometimes consulted with them about my concerns, such as research budget allocation and when to apply for a permanent research position at NIMS.

What I appreciated the most from my peers was that they helped increase my motivation to engage in research. When I was a college student, I saw myself as the most diligent researcher there. However, at the ICYS, I saw that some of my peers were working later than I was, driving me to work even harder. When my ICYS term ended in March 2022, I was so emotionally attached to the common room that I even thought about ways in which I could stay there longer.

Generous support for a wide range of activities

Hill: International researchers often face many difficulties both in their private and professional lives when settling in Japan. The ICYS provided me with generous support in English, making my transition very smooth. This included renting a house, my children's schooling and accessing medical services.

Matsumoto: Many of my activities involve English, such as publishing research and purchasing equipment. ICYS staff proficient in English help me with these activities. In addition

to their assistance with English, they have also helped me with miscellaneous tasks, including setting up projectors before conferences. I greatly appreciate their generous support. When one of the staff members retired this February, we all lined up along the hallway to see her off. Thinking about all the support and help she provided, I became very emotional. I also received helpful technical support from engineers for my experiments.

Transition from two years of intense research to a permanent NIMS research position

Matsumoto: To qualify for a permanent research position at NIMS, applicants need to pass a document evaluation and an interview exam. Although ICYS research fellows are treated preferentially in the document evaluation, they are treated the same as other applicants in the interview exam. In retrospect, I feel that the two-year ICYS program—which fully supported my independent research—was the real preferential treatment. I believe that this program, especially the mentoring I received, helped me develop the research ethics, philosophy and methodologies that prepared me to become a permanent researcher at NIMS.

Hill: Joining the ICYS was also a critical life decision for me. If I had chosen to leave Japan, my career would have been completely different. Working at the ICYS may also be advantageous for those interested in pursuing permanent research positions at NIMS. They can get to know the people who work at NIMS and

their ongoing research projects.

I've been working at NIMS for 18 years, including my two-year ICYS term. This continuity has enabled me to carry out ambitious, long-term research. I feel really fortunate for that. I have also been able to work with some of my group members for many years.

Message to young potential ICYS program applicants

Matsumoto: In the region where I grew up, pursuing a doctoral program was uncommon

and research careers were very limited. When I relocated to attend the University of Tsukuba-NIMS Joint Graduate School, my family and friends worried about me. However, I had a clear vision of becoming a researcher, and the ICYS research fellowship offered me a great opportunity to bring this dream into reality. Young researchers should explore opportunities to conduct research that keenly interests them.

Hill: I think young people should pursue their dreams. If your passion is research, the ICYS program is a viable option for you. Because

science is a creative endeavor, I want young scientists to enjoy creative research processes designed to achieve their goals. I recommend that motivated researchers consider the ICYS program as a potential option.

Matsumoto: I agree. If you have enough motivation, the great support you can get from mentors and peers may make the ICYS an ideal place for you. That was certainly my experience.

(by Akiko Ikeda)

* The duration of an ICYS appointment will change from April 2023. See the lower section of p. 15 for details.

Jonathan Patrick Hill

Group Leader,
Functional Chromophores Group,
International Center for Materials
Nanoarchitectonics (WPI-MANA)

Hill graduated from Kingston University in the UK in 1990 and earned his Ph.D. from Brunel University in London in 1995. He then worked at the Osaka National Research Institute (currently AIST Kansai) and the University of Karlsruhe (currently the Karlsruhe Institute of Technology) in Germany and participated in the ERATO-funded AIDA Nanospace project. He became an ICYS research fellow in 2004 and then a permanent researcher at NIMS in 2006. He assumed his current position at NIMS in 2020.



CASE 1 ICYS provides all the necessary resources to enable research fellows to hit the ground running.

ICYS Research Fellow
Yuichi Hirai

Some materials are known to emit light when force is applied to them. This phenomenon is called triboluminescence. Although triboluminescence was discovered more than 400 years ago, its mechanisms remain unknown. This lack of understanding is mainly attributed to the difficulty of distinguishing light generated by triboluminescence from light generated by ultraviolet irradiation, as they have similar optical spectra. It's also difficult to measure micro structural changes in crystals that cause triboluminescence and determine when this phenomenon occurs. Dr. Yuichi Hirai discovered a material which emits red light when irradiated with ultraviolet radiation and yellow light when it is mechanically pulled apart. Hirai is now attempting to reveal the long-standing mystery of triboluminescence using state-of-the-art lab equipment at NIMS.

Soon after Hirai started working at ICYS, he was intrigued by a device which he later used to significantly advance his triboluminescence research: a nanomechanical testing system capable of applying force to a small target spot in a crystal and accurately measuring deformation processes in response to the force applied. Because this instrument was designed for purposes other than triboluminescence research, it didn't initially occur to Hirai that he could use it in his research. However, when he attended an ICYS seminar for the first time, the presentation touched on the nanomechanical testing system, making him realize that the device could be useful in his research. When he

asked ICYS Managing Director Tsuchiya about the device, Tsuchiya encouraged him to try using it. Tsuchiya then directed Hirai to the researcher who manages the device. Hirai later discovered mechanical characteristics unique to triboluminescent crystals using the nanomechanical testing system. "When I applied for the ICYS program, I proposed a research project designed to investigate the relationship between triboluminescence and crystal structures," Hirai said. "Because of this discovery, my main research focus has since evolved to focus on the nanomechanical characteristics of triboluminescent materials. I'm pleased with this development."

Convenient access to cutting-edge equipment

ICYS research fellows are independent of any research groups at NIMS. Hirai sees this as an advantage: his position makes it easier for him to access the different resources available at NIMS, including lab equipment, other researchers and technicians. NIMS has an array of state-of-the-art equipment for different purposes. "For example, the Luminescent Materials Group has a single-crystal X-ray diffractometer with among the best specifications for lab use," Hirai said. "I have easy access to this very valuable equipment when I need to perform crystal screening."

A Mentor Speaks

Senior Researcher,
Luminescent Materials Group
Research Center for Functional Materials

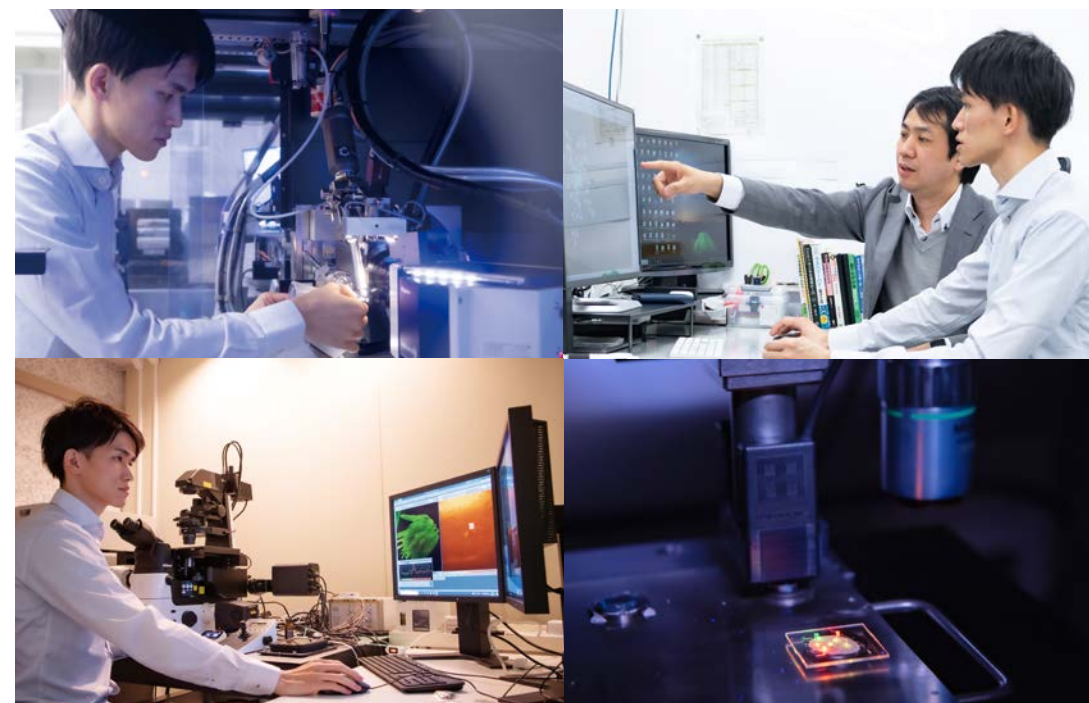
Takayuki Nakanishi

Dr. Hirai is working on a very complex project involving interactions between the nanomolecular properties of a rare-earth element-organic molecule complex and the macroscopic mechanical properties of a molecular crystalline solid. I have been supporting his ambitious endeavor by having a series of discussions with him while respecting his ideas and helping him find effective solutions to the problems he encounters. He diligently pursues research subjects that genuinely interest him. He also has a strong desire to contribute to society through his research. I have great expectations for him as a young and talented materials researcher. I hope he will develop a broad, interdisciplinary perspective and a flexible approach to problems.

Group Leader,
Electronic Functional Macromolecules Group
Research Center for Functional Materials

Masayoshi Higuchi

Dr. Hirai is challenging without hesitation to scientifically unsolved chemical phenomena which are difficult to unravel the mechanism and I respect his such pure attitude to researches. My long research career lets me know that researchers can immerse themselves in their own research only for a shorter period than expected. So, I understand that my role as mentor is to support him so that he can concentrate on his research. I am concerned the researcher population in Japan is now shrinking. I expect Dr. Hirai to find fundamental principles behind chemical and physical phenomena and to become a leading researcher of Japan's scientific community in the future.



Upper left: Hirai mounting a crystal on a single-crystal X-ray diffractometer.

Upper right: Hirai having a discussion with Senior Researcher Nakanishi, his mentor, about triboluminescence mechanisms based on molecular structural analyses Hirai made.

Lower left: Hirai making luminescence spectrum and other measurements using a confocal laser scanning microscope.

Lower right: This nanoindentation tester is capable of tracking deformation processes on a sample material on the order of nanometers.

Hirai conducted his postdoctoral research at universities in the United States and France. At these places, he was sometimes unable to perform crystal structural analysis because some of the lab he had belong to did not have the equipment and he had to ask research collaborators at different locations to do it for him. "I sometimes had to wait for a month to see the results," Hirai said. "Because this process took a long time and was inconvenient, I carefully selected the crystal samples to ship for analysis. I only sent large, high-quality crystals that were conducive to accurate measurements."

Hirai now has access to the single-crystal X-ray diffractometer; he even has the luxury of setting it to perform automatic measurements all night long. In addition, the time required to make crystal structural measurements has been significantly shortened, enabling Hirai to measure a vast number of samples. As a result, he was able to discover many crystal structures that were previously unknown to exist. The researcher who manages the equipment and the technician proficient in its use are also very supportive of Hirai: they are willing to discuss his questions and requests, such as measurement methods and augmentation of the equipment.

"Micro crystals and large, grown crystals often exhibit different structural, optical and nanomechanical properties even when their compositions are the same," Hirai said. "During the process of recrystallization, powders (that are often micro crystals) are deposited on the walls of the sample tubes which most researchers disregard as "not for struc-

tural analysis". However, my results suggest that these small particles may provide a clue to new discoveries. In fact, I was able to identify three new crystal structures from triboluminescent molecules as a result of analyzing micro crystals."

Discretionary research budget

Each ICYS research fellow receives a research budget of two million yen which can be spent from the first day of their appointment. "Even if you acquire competitive funding from external sources (e.g., the JSPS Grant-in-Aid for Scientific Research), you cannot spend it until the following year," Hirai said. "For ICYS research fellows with two-year contracts, this type of funding can only be spent in the second year of their term. The initial funding at the ICYS allows its research fellows to immediately begin their projects, like a rocket fully loaded with fuel and ready for launch." Postdoctoral researchers who work on university projects also receive research funding from their advisors. However, they need to ask permission from their advisors for each and every disbursement (e.g., to attend research meetings or purchase chemical reagents). "I have some hesitation when I consider purchasing something I want to use for my project that isn't absolutely necessary (e.g., chemicals)," Hirai said. "However, such purchases may allow me to conduct new experiments leading to potential new insights." Hirai has been carrying out additional experiments concurrent with his main project to identify potential new subjects for future research.

Supportive staff and mentors

The NIMS administrative staffs provide a variety of support for ICYS research fellows. Their services include ordering chemicals and lab equipments and managing travel expenses and research budgets. "NIMS has specific rules for various activities, such as business trips," Hirai said. "However, finding and reading documents describing these rules may take time. Experienced staff members have kindly taught me these rules, allowing me to spend more time on my research."

The mentor system is another distinctive ICYS feature. "I have some anxiety about whether my research proposal has really been mapped out well enough to produce satisfactory results within the two-year term," Hirai said. "My mentors pay attention to the way in which my project is progressing and give me helpful advice to ensure that I'm on the right track. In universities, professors usually work mainly as supervisors and are not directly involved in experiments. By contrast, ICYS mentors actually take part in their experiments. The ICYS mentor system therefore enables me to consult with my mentors about the specific details of my experiments in addition to general research directions."

Hirai says the ICYS provides an ideal postdoctoral research environment. He is working diligently with the hope of making great accomplishments during his two-year term. (by Kaori Oishi)

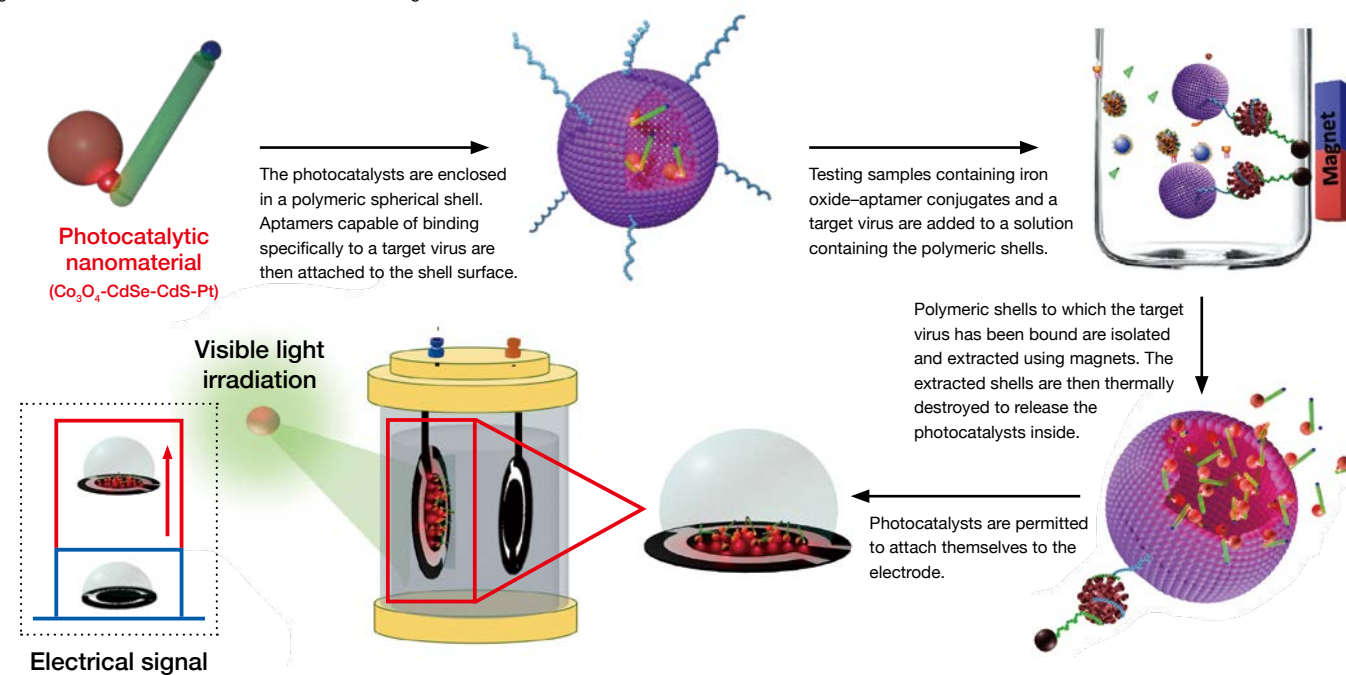
CASE 2 No power supply required! Development of ultra-sensitive virus detection sensor using light



ICYS Research Fellow
GANGANBOINA Akhilesh Babu

The COVID-19 pandemic is still raging. PCR and antigen tests are used to diagnose infections, but PCR tests take time and antigen tests can be inaccurate. Dr. Ganganboina sought to create a completely new virus detection sensor to solve this problem. The key is a photocatalytic nanomaterial. Ganganboina designed a nanomaterial that emits a strong electrical signal when irradiated with light. He then devised a mechanism to amplify the signal many times by surrounding a large amount of the nanomaterial with a polymer and proceeded to synthesize it (see the figure). Testing has confirmed that the synthesized molecules exhibit significant catalytic action even in direct sunlight. This research is expected to result in an ultra-sensitive virus detection sensor able to diagnose infection on the spot even in environments without power or fresh water.

Figure. Mechanism of the virus detection sensor Ganganboina is developing



Ganganboina's mentors help him develop nanomaterials

"From an early age, I was interested in how the human body works, especially the causes of illness," Ganganboina said. In graduate school, he learned the importance of virus detection sensors, and during his post-doctorate program, he participated in research to improve their sensitivity, selectivity and reliability. Meanwhile, the COVID-19 outbreak occurred. In order to prevent the spread of infection, the development of biosensors has

been accelerating all over the world. However, developing countries lack the power supplies and facilities required for testing, leaving the virus to spread unchecked. "I felt a strong sense of mission," Ganganboina said. "I needed to develop a virus detection sensor that can accurately diagnose infection in developing countries on the spot." Developing such a sensor would require materials research. After he joined ICYS with this objective in mind, his mentors inspired a breakthrough.

The sensors that Ganganboina wanted to develop would require materials able to effi-

ciently cause photocatalytic reactions. Size was also important: the more photocatalytic material could be incorporated into a sensor, the greater the signal amplification. Ganganboina proceeded to design and develop a few. However, verifying the properties of a new material is often difficult. Ganganboina says he felt very fortunate to have two mentors: Dr. YE, a photocatalyst expert, and Dr. Okamoto, an electrochemistry expert. "The material I developed is a complex combination of multiple structures: zero-dimensional quantum dots, one-dimensional quantum rods, hollow

metal oxides and metal nanoparticles," he said. "I proceeded to verify the efficiency of the material's photocatalytic reactions while consulting with my mentors, and I was able to confirm that the new nanoscale photocatalytic material is very efficient."

Wide-ranging research while learning research management

Ganganboina also received useful advice from his mentors on research management. "Many obstacles still need to be overcome to complete the sensor," he said. "It would be ideal if I could wait until completion to announce the results, but preliminary results are also required. I learned a lot about when I should publish, how to obtain research funds and budget management. My mentors' accurate advice and respect for my independent research were very helpful."

Ganganboina also started jointly researching a sensor to detect the bacteria that cause periodontal diseases with Okamoto. "These encounters with my mentors greatly expanded the scope of my research," he said.

Ganganboina's work at NIMS has also exposed him to cutting-edge new technologies that can potentially be applied to his own research. "Seminars and even coffee breaks at NIMS have led to 3 joint research projects. The development of my sensor requires knowledge of both biosensors and nanomaterial synthesis. At NIMS, we can learn from leading researchers, and new and exciting ideas are born."

ICYS, the best environment for young researchers, innovative and committed to success

Research cannot proceed unless the ideas it generates can be implemented. ICYS research fellows are given funds to carry out research independently (e.g., by purchasing equipment and attending academic conferences). "I really enjoy the freedom to study what is really interesting to me in my career as a postdoc,"

Ganganboina said. "ICYS is the perfect environment for innovative young researchers who are determined to succeed."

Ganganboina reiterated its drive to make the sensor a reality. "I am confident that this will revolutionize virus detection sensors. We hope to develop a prototype that we can commercialize and deliver to the world within a few years".

A Mentor Speaks



Group Leader, Electrochemical Nanobiotechnology Group, International Center for Materials Nanoarchitectonics (WPI-MANA)

Akihiro Okamoto

All ICYS research fellows are very talented and professional in their areas of expertise. My job as Dr. Ganganboina's mentor is to give him advice from my professional perspective to give him fresh insights. He is eager to incorporate new information and adopt new methodologies. He also has a kind personality, making it easy for him to make friends with his coworkers. These traits can be very helpful when pursuing a research career. I hope he will become a standout among the many excellent materials researchers at NIMS.



Group Leader, Photocatalytic Materials Group, International Center for Materials Nanoarchitectonics (WPI-MANA)

Jinhua Ye

I have been providing Dr. Ganganboina with advice on synthesizing nanomaterials, evaluating their photoelectrochemical reactions and analyzing the mechanisms of these reactions. He enthusiastically works on a variety of research subjects in active cooperation with other researchers. His research ethics are also impressive. I hope that he will carry out creative research leading to true innovations, setting an example for other young researchers at NIMS.



"Discussions with my mentor help me gain new insights," Ganganboina says.

Generous administrative support



Administrative Staff
Global Program Office
International Support Group
Maki Kosaka

ICYS Research Fellow
Pelin Tozman Karanikolas

The Global Program Office provides administrative support to ICYS research fellows (e.g., budget management and application preparation) to enable them to fully focus on their research. In addition, the office helps international researchers settle in Japan smoothly and comfortably by assisting them with their various needs, such as the immigration process and daily life. Maki Kosaka is a Global Program Office staff member and Pelin Tozman Karanikolas is an ICYS research fellow from Turkey who has been conducting research on magnets. Both who work together often, discussed the Global Program Office's services to ICYS research fellows by sharing their personal experiences.

Kosaka: My primary responsibility is to provide administrative support to ICYS research fellows, including help with budget management, purchasing, attendance management, preparation of various applications, research publication and participation in scientific conferences. I also provide administrative support to researchers at the ICYS by helping them with their various needs, including the immigration process and daily life. I'm currently assisting six international researchers, including Dr. Tozman. Although I assumed my current role only last February, I feel like I've known her much longer because we've been working closely on matters, including last-minute purchases before the end of a fiscal year.

Tozman: I was very busy with my research toward the end of FY2021, and I couldn't make necessary purchases until the last minute before the fiscal year purchasing deadline. Ms. Kosaka helped me with these purchases. I'm grateful for her support in English. Even if I had better Japanese language skills, I would still have very much relied on Ms. Kosaka's support, which has enabled me to concentrate on my research.

Kosaka: I know that research is a very chal-

lenging profession because my husband is a researcher from overseas. I'm more than happy to help international researchers focus on their projects without worrying about administrative matters. Thinking about the fact that my husband needs a great deal of support at his workplace motivates me to be helpful here.

Tozman: Ms. Kosaka also helped me with a research grant application. The application process itself was relatively straightforward, but once my proposal was funded, I had to fill out and submit some additional forms that were quite tedious and detailed. This process troubled me greatly. Although I received instructions for these forms in English, they were so long that I couldn't find the information I was looking for.

Kosaka: We worked on this problem together. We phoned the office to which she needed to submit the forms and filled out the forms together on a computer while listening to verbal instructions. By the way, how do you find information on research grants offered by Japanese organizations?

Tozman: The ICYS Managing Director and secretariat and my coworkers in the lab have provided me with research grant information

and suggested that I apply. They kindly explained these grants to me or emailed me links to webpages that describe how to apply for them. However, some of the instructions were written only in Japanese, discouraging me from applying.

Kosaka: Please ask me whenever you need help. We're both working mothers and I can thus relate well to you. I look forward to being of service to you in the future.

Tozman: I previously worked at NIMS as a postdoctoral researcher and found that it had a very robust support system for international researchers. This experience gave me confidence about returning to Japan in 2019 to work at the ICYS. In fact, I'm pleased with my current research environment: I've been able to fully concentrate on my research using NIMS' top notch research resources, including the support system represented by Ms. Kosaka. (by Akiko Ikeda)



Tozman's research

Public interest has grown in electric vehicles and wind power generations to achieve carbon neutrality. I study the magnets essential to improve the efficiency of motors (generators) for these technologies. I intend to increase the performance of magnets used in motors. I've focused on samarium-iron-based magnets because they use more abundant raw materials than currently available neodymium magnets. I try to improve the heat resistance of these magnets.

Diverse career path options

CASE 1 An ICYS alumnus becomes a permanent researcher at NIMS.



Principal Researcher,
Magnetic Materials Analysis Group,
Research Center for Magnetic and
Spintronic Materials

Hossein Sepehri Amin

Educational and professional background

Sepehri Amin earned his bachelor's degree from Tehran University in Iran and his master's degree from Isfahan University of Technology in Iran. He enrolled in the University of Tsukuba-NIMS Joint Graduate School in 2008. Throughout his doctoral studies there, he was supported by a NIMS Graduate Research Assistantship. After earning his Ph. D. degree from the University of Tsukuba in March 2011, he worked as a postdoctoral researcher and became an ICYS research fellow. He has been a permanent researcher at NIMS since 2014. He also became an associate professor at the University of Tsukuba in 2022.

Since I was studying magnetic materials in my master's course, I knew NIMS as a research institute that conduct excellent research from the publications. Furthermore, at NIMS, which I visited for the entrance examination of the doctoral course, I witnessed a fulfilling research environment and decided to study here. Although I received some admissions from different universities in Europe and the United States, I decided to join the University of Tsukuba-NIMS Joint Graduate School and worked on correlation of microstructure and magnetic properties of Nd-Fe-B

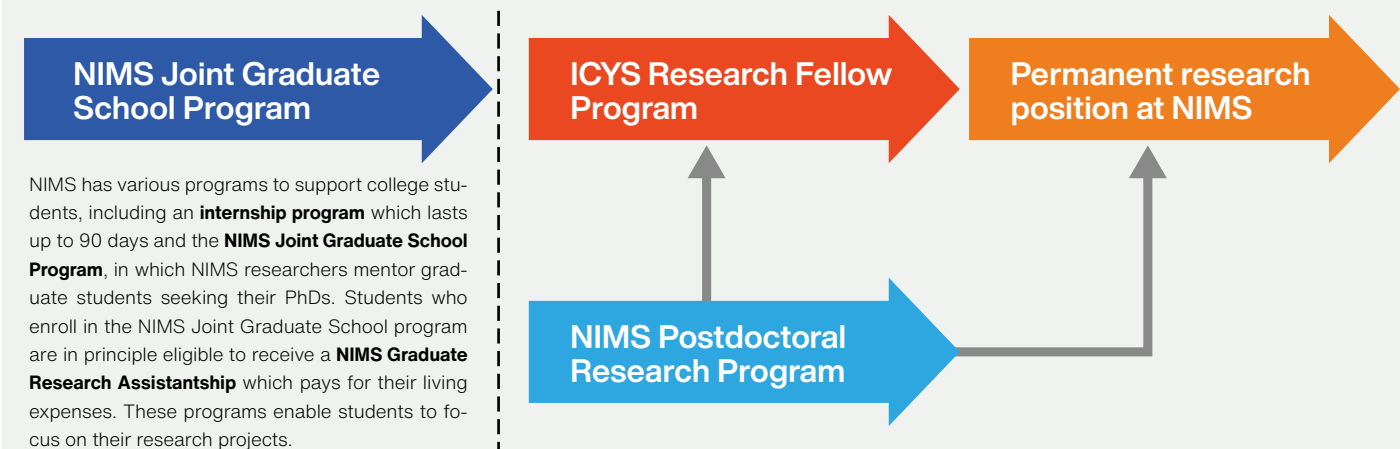
based permanent magnets.

As a career path after obtaining a doctoral degree, ICYS is very attractive because ICYS fellows can conduct their research independently, and are provided with research funds. There was no reason not to apply. At ICYS, we broadened our research horizons by discussing with researchers in various fields such as material science, physics, and chemistry. Since I started my ICYS position, I expanded my research to include not only Nd-Fe-B magnets but also various types of permanent magnets, magnetocaloric materials, and en-

ergy-assisted magnetic recording. I also worked on finite element micromagnetic simulation.

Being able to conduct research in an always stimulating environment led to my application for a permanent staff at NIMS, and I am still living a fulfilling research life. Indeed, I was able to gain unique experience in building my career at ICYS. Now, I am in a position to accept students. I would like to give back my experience to young researchers.

NIMS programs that support college graduates as they pursue PhDs, conduct postdoctoral research and become permanent researchers



NIMS has various programs to support college students, including an **internship program** which lasts up to 90 days and the **NIMS Joint Graduate School Program**, in which NIMS researchers mentor graduate students seeking their PhDs. Students who enroll in the NIMS Joint Graduate School program are in principle eligible to receive a **NIMS Graduate Research Assistantship** which pays for their living expenses. These programs enable students to focus on their research projects.

More details about the NIMS Graduate Program

This program allows qualified graduate students to carry out research at NIMS—a world-class materials research institution—during their doctoral programs. Please scan this QR code to learn more about the program (e.g., how it works, types of research you can conduct, lives of program participants, information on the NIMS Graduate Research Assistantship and how to apply for the program).



CASE 2 Former ICYS research fellow builds an outstanding research career in his home country



Professor,
University College London (UCL)

David Bowler

Educational and professional background

Professor Bowler earned a B.A. from Cambridge University and a Ph.D. from Oxford University. After working as a postdoctoral researcher at Keele University and UCL, he became an ICYS research fellow in 2004. He then joined UCL as a lecturer and later became a professor there. Since 2016, he has also been working as a Satellite Principal Investigator at MANA, NIMS.

Throughout my professional career, I have worked on developing CONQUEST, a computer program for performing large-scale first principles calculations. This program was developed through collaboration between UCL and NIMS, and I continued my work on it when I was an ICYS member. CONQUEST is still being developed today. My experience at ICYS early in my research career was very valuable, and has enabled me to maintain a collaborative relationship with NIMS for the last fifteen years.

I was initially encouraged to apply for the ICYS program by Tsuyoshi Miyazaki at NIMS, a co-developer of CONQUEST. ICYS provided me with generous research support, helped me adjust to life in Japan (which I greatly appreciated as a father of three young children) and gave me the freedom to pursue my research in a very active environment. As a result, my professional and private life in Japan was very stimulating. I was also impressed by the exceptionally diverse areas of research

conducted at NIMS in addition to my area of expertise: computational materials science.

ICYS gives young researchers considerable independence in their early careers, which is very important in deciding which research

directions to pursue. I would strongly encourage young researchers to apply to ICYS, which gives research freedom, extensive support and valuable experience of different cultures.

Career path after graduating from ICYS

- CNRS (Centre national de la recherche scientifique, France)
- Chinese Academy of Sciences (China)
- EMPA (Swiss Federal Laboratories for Materials Science and Technology)
- EPFL (Ecole polytechnique fédérale de Lausanne, Swiss)
- Max Plank Institute (Germany)
- Peking University (China)
- Pusan National University (Korea)
- University College London (UK)
- University of Bristol (UK)
- UCLA (USA)
- University of Oxford (UK)
- York University (UK)
- Samsung Electronics Co., Ltd. (Korea) etc



ICYS statistics

Proportion of ICYS alumni who acquire a permanent research position at NIMS

54.8%

* Based on data collected from FY2016 to FY2021

ICYS admission rate approximately

2.3%

* Of 876 applications submitted between FY2019 and FY2021, 20 applicants were accepted.

Duration of appointment

3 years under the initial contract,
5 years maximum

* This applies to those who join the ICYS in April 2023 or later. An initial appointment is three years. A maximum of two one-year extensions may be granted to qualified appointees.

* When NIMS employees are admitted to this program, their contracts may vary depending on their previous positions at NIMS.

Annual research funding per ICYS research fellow

2 million yen

* Researchers who launch their projects at a time other than the beginning of a fiscal year will receive one-twelfth of the annual amount monthly.

Annual salary **6.04** million yen or higher

* This applies to those who join the ICYS in April 2023 or later.

Number of ICYS alumni

169 number of nationalities **29**

* Cumulative numbers from the 19 years from FY2003 to FY2021

Proportion of foreign nationals to Japanese nationals among ICYS research fellows

52.3%

* As of July 1, 2022

THE 5 QUESTIONS for the ICYS Managing Director



Managing Director,
International Center for Young Scientists (ICYS)
Koichi Tsuchiya

Q How does one apply for the ICYS program?

A We call for applications twice a year (Aug-Sep and Feb-Mar). Please send your application package (research proposal, CV, DOIs for your publications, etc.) to the ICYS Recruitment Desk by email at icys-recruit@nims.go.jp.



For further details about applying and to download the necessary forms, please visit our website:

Q How does the ICYS program differ from other postdoctoral programs?

A ICYS research fellows are free to propose their own research subjects, whereas normal postdoctoral programs request researchers to work on predetermined subjects. In addition, ICYS research fellows can fully exploit NIMS' high-quality research environment for their projects.

Q How do you assess applications? What aspects are most important?

A Submitted applications will be reviewed by NIMS researchers with expertise in the applicants' areas of research interest. Applicants who make it through this process will be asked to come for an interview which includes a 30-minute oral presentation and a 30-minute Q&A session. We are particularly interested in the quality of the research papers applicants have published and the originality and innovativeness of their research proposals.

Q Who should consider applying for the ICYS program?

A Applicants should be willing to fully dedicate themselves to their research without fear of failure. I think complete commitment is the key to making new discoveries and gaining valuable experience, even if the one fails to produce the desired result.

Q Could you give a message to young researchers who may want to apply for the ICYS program?

A For people who have just earned their PhDs and intend to pursue careers as research scientists, the 10-year postdoctoral period is crucial in determining their life as researchers. I think young researchers would be very fortunate to have the opportunity to fully focus on their areas of interest side-by-side with the colleague with the same will. This experience could be invaluable. I look forward to meeting these ambitious newcomers.

Materials

Change the world,
We make the materials.

Open Positions

World-Top-Class Leaders

Start-up fund of up to 100 million JPY

Applications for permanent positions accepted throughout the year

Group Leaders

Start-up fund of up to 30 million JPY

Applications for permanent positions accepted throughout the year

Researchers, Engineers

Start-up fund of up to 10 million JPY (Researcher)

Applications for permanent positions accepted March–May, September–October

ICYS Research Fellows

Independent and self-directed research

Research grant of 2 million JPY/year

Advantage on permanent position application (Approx. 50% chance of obtaining the position)
Applications accepted February–March, August–September

NIMS Postdoctoral Fellows

Career advancement in cutting-edge research facilities
Recruiting throughout the year

NIMS Junior Researchers

(For graduate students) Earning a Ph.D. with financial support in a world-class research environment



For more information, visit
<https://www.nims.go.jp/eng/employment/index.html>

※Photo: Ce:YAG single-crystal phosphor



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R70

Percentage of Waste
Paper pulp 70%



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