

Organic and Carbon Nanomaterials Unit (Akimitsu Narita)

FY2023 Annual Report

Organic and Carbon Nanomaterials Unit
Assistant Professor Akimitsu Narita

Abstract

FY2023 was the fourth year of research activities physically at OIST after the opening of Lab4 in 2020. The unit welcomed Dr. Gao Zhiqiang (Postdoctoral Scholar), Dr. Md Imrul Khalid (Postdoctoral Scholar), Dr. Ian Cheng-Yi Hou (Postdoctoral Scholar), and Ms. Hui Zhang (Part-Time Research Assistant). We also hosted two OIST rotation students, three Research Interns, and Dr. Marco Di Giovannantonio from the Italian National Research Council (CNR) as a Visiting Researcher for collaborative experiments on a project supported by JSPS Bilateral Program with CNR. We continued to work on the synthesis and characterizations of functional nanographene molecules as well as in-depth studies of their properties and potential applications in collaboration with internal and external partners, resulting also in a new patent application with the Max Planck Institute for Polymer Research. We completed the JSPS KAKENHI project No. 19K24686 and continued to work on the project supported by the JSPS International Joint Research Program with German Research Foundation (JRP-LEAD with DFG) besides other ongoing JSPS KAKENHI projects and the EU project "LIGHT-CAP" as an extra-EU partner. We hosted and co-organized "OIST-ICReDD Joint Seminar on Molecular Materials and Catalysis" and "JST-OIST Joint Symposium on Circularly Polarized Luminescence and the Related Phenomena" at OIST.

1. Staff

- Dr. Zakaria Ziadi, Staff Scientist
- Dr. Xiushang Xu, Postdoctoral Scholar
- Dr. Jingyun Tan, Postdoctoral Scholar
- Dr. Hao Zhao, Research Fellow (JSPS Postdoctoral Fellow)
- Dr. Niklas Maximilian Bojanowski, Research Fellow (JSPS Postdoctoral Fellow, -2023.11)
- Dr. Clément Delacou, Interdisciplinary Postdoctoral Fellow
- Dr. Gao Zhiqiang, Postdoctoral Scholar (2023.10-)
- Dr. Md Imrul Khalid, Postdoctoral Scholar (2023.11-)
- Dr. Ian Cheng-Yi Hou, Postdoctoral Scholar (2024.3-)
- Mr. Takatsugu Onishi, OIST PhD Student
- Mr. Saurav Raj, OIST PhD Student
- Dr. Marco Di Giovannantonio, Visiting Researcher (2023.4-5)
- Ms. Hui Zhang, Part-Time Research Assistant (2024.3-)
- Mr. Xingfu Zhu, Research Intern (2023.6-7)
- Mr. Jolan Bonelli, Research Intern (2023.10-)
- Mr. Islam Salem Marae Nasar, Research Intern (2023.12-)
- Mr. Kaede Kawaguchi, OIST rotation student (2023.5-8)
- Mr. Thomas Johannes Hasiweder, OIST rotation student (2023.9-12)
- Ms. Ayumi Shimojima, Research Unit Administrator

2. Collaborations

2.1 Synthesis and Functionalization of Polycyclic Aromatic Hydrocarbons (PAHs) and Graphene Nanoribbons (GNRs)

- Type of collaboration: Joint research
- Researchers:
 - Prof. Klaus Müllen, Max Planck Institute for Polymer Research (MPIP), Mainz, Germany
 - Prof. Xinliang Feng, Faculty of Chemistry and Food Chemistry and Center for Advancing Electronics Dresden, Technical University of Dresden, Germany
 - Prof. Yunbin Hu, College of Chemistry and Chemical Engineering, Central South University, Changsha, China
 - Prof. Dennis Chung-Yang Huang, Institute for Chemical Reaction Design and Discovery (ICReDD), Hokkaido University, Sapporo, Hokkaido, Japan
- Recent publications: *J. Am. Chem. Soc.* **2024**, *146*, 7480; *Angew. Chem. Int. Ed.* **2024**, *64*, e202400172; *Angew. Chem. Int. Ed.* **2023**, *62*, e202218494.

2.2 On-Surface Synthesis and Characterizations of Nanographenes and GNRs

- Type of collaboration: Joint research
- Researchers:
 - Prof. Roman Fasel, nanotech@surfaces laboratory, Empa – Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland
 - Dr. Marco Di Giovannantonio, Consiglio Nazionale delle Ricerche (CNR), Istituto di Struttura della Materia (ISM), Roma, Italy (Italian PI of a JSPS Bilateral Joint Research Project with CNR)
 - Dr. José Ignacio Urgel, Prof. David Écija, Institute for Advanced Studies in Nanoscience (IMDEA Nanoscience), Madrid, Spain
 - Dr. Antoine Hinaut, Prof. Ernst Meyer, Department of Physics, University of Basel, Basel, Switzerland
 - Prof. Yoshinori Okada, Quantum Materials Science Unit, OIST
 - Prof. Shigeki Kawai, National Institute for Materials Science (NIMS), Tsukuba, Japan
- Recent publications: *Nat. Commun.* **2024**, *15*, 1910; *Adv. Mater.* **2023**, *35*, 2306311; *Angew. Chem. Int. Ed.* **2023**, *62*, e202302534 (Selected as the Back Cover); *Angew. Chem. Int. Ed.* **2023**, *62*, e202312610.

2.3 Investigations of Nanographene-Based Fluorophores for Super-Resolution (Bio)imaging

- Type of collaboration: Joint research
- Researchers:
 - Prof. Mischa Bonn, MPIP, Mainz, Germany
 - Dr. Xiaomin Liu, MPIP, Mainz, Germany
 - Prof. Marco Terenzio, Molecular Neuroscience Unit, OIST
- Recent publications: *J. Am. Chem. Soc.* **2024**, *146*, 5195 (Selected as the Cover); *Adv. Funct. Mater.* **2024**, *34*, 2308110.

2.4 Investigations of Photophysical Properties of Nanographenes and Their Functionalized Derivatives

- Type of collaboration: Joint research
- Researchers:
 - Dr. Giuseppe M. Paternò, Physics Department, Politecnico di Milano, Italy
 - Prof. Francesco Scotognella, Dipartimento Scienza Applicata e Tecnologia (DISAT), Politecnico di Torino, Italy
 - Prof. Guglielmo Lanzani, Center for Nano Science and Technology, Istituto Italiano di Tecnologia (IIT), Milano, Italy; Physics Department, Politecnico di Milano, Italy
 - Prof. María A. Díaz-García, Departamento de Física Aplicada and Instituto Universitario de Materiales de Alicante, Universidad de Alicante, Spain
 - Prof. Ryota Kabe, Organic Optoelectronics Unit, OIST
 - Prof. Andrew Musser, Department of Chemistry & Chemical Biology, Cornell University, Ithaca, NY, USA
 - Dr. Juan Cabanillas Gonzalez, IMDEA Nanoscience, Madrid, Spain

- Recent publications: *Small* **2023**, *19*, 2301596. (Selected as the Back Cover); *Angew. Chem. Int. Ed.* **2023**, *62*, e202218350; *Chem. Commun.* **2023**, *59*, 720; *Chem. Sci.* **2022**, *13*, 13040.

2.5 Hybridization of Nanographenes and 2D Materials and Investigation of Interlayer Charge/Energy Transfer

- Type of collaboration: Joint research
- Researchers:
 - Prof. Mischa Bonn, MPIP, Mainz, Germany (German co-PI of a project funded by JRP-LEAD with DFG)
 - Dr. Hai Wang, Utrecht University, Utrecht, The Netherlands; MPIP, Mainz, Germany
 - Prof. Teresa Gatti, DISAT, Politecnico di Torino, Italy
 - Prof. Bernd Smarsly, Justus Liebig University Giessen, Germany (German PI of a project funded by JRP-LEAD with DFG)
 - Prof. Silvio Osella, Centre of New Technologies, University of Warsaw, Warsaw, Poland
- Reference: *J. Chem. Phys.* **2022**, *156*, 074702.

2.6 Investigations of Photoluminescence Properties and Single-Photon Emission of PAHs and GNRs

- Type of collaboration: Joint research
- Researchers:
 - Prof. Jean-Sébastien Lauret, Ecole Normale Supérieure de Paris Saclay, Orsay cedex, France
 - Dr. Stéphane Campidelli, CEA-Saclay, Gif sur Yvette, France
- References: *Nanoscale* **2022**, *14*, 3826; *J. Chem. Phys.* **2022**, *156*, 104302.

2.7 Application of Functionalized PAHs for Perovskite Solar Cells

- Type of collaboration: Joint research
- Researchers:
 - Prof. Yabing Qi, Energy Materials and Surface Sciences Unit, OIST
- Recent publication: *Adv. Mater.* **2023**, *35*, 2300169.

2.8 Optical Trapping of Polymeric Nanoparticle Containing Nanographenes

- Type of collaboration: Joint research
- Researchers:
 - Prof. Síle Nic Chormaic, Light-Matter Interactions for Quantum Technologies Unit, OIST
- Recent publication: arXiv:2404.17307

3. Activities and Findings

3.1 Solution Synthesis of Nanographenes and Exploration of Their Potential Applications

Large polycyclic aromatic hydrocarbons (PAHs) are attracting increasing research attentions as nanographenes or atomically precise graphene quantum dots (GQDs) with unique electronic, optical, and magnetic properties. We have been working on the functionalization of dibenzo[*hi, st*]ovalene (DBOV) as highly luminescent nanographene with strong red emission (cited from FY2022 Annual Report). In this fiscal year, we have completed our first publication about the super-resolution bioimaging using functionalized DBOV as a blinking fluorophore for the single-molecule localization microscopy (SMLM) in collaboration with our partners at MPIP (collaboration 2.2). In particular, working together with Molecular Neuroscience Unit at OIST, we achieved the super-resolution imaging of nascent proteins in primary sensory neurons via click chemistry using azide-functionalized DBOV (*J. Am. Chem. Soc.* **2024**, *146*, 5195). We also continued the synthesis of novel DBOV derivatives with different functions toward bioimaging and biosensing applications, closely working with our collaborators. Moreover, together with MPIP and Organic Optoelectronics Unit, we investigated unique photoinduced fluorescence recovery in nanographenes, which enabled continuous super-

resolution imaging by the stimulated emission depletion microscopy (STED), and filed a patent application (EP24165695.8). On the other hand, we synthesized a tetrabenzodiphenylpyrene (TBDNP) derivative as a chiral nanographene with zigzag and fjord edge structures, which demonstrated near-infrared (NIR) emission in the range of 800–1000 nm with a photoluminescence quantum yield of 14% (*Adv. Funct. Mater.* **2024**, *34*, 2308110). Besides, TBDNP showed notable chiroptical activities from 300 to 850 nm with a high dissymmetry factor of 0.032 at 574 nm as well as the self-blinking properties like DBOV, promising for the development of NIR fluorophores for SMLM.

3.2 On-Surface Synthesis of Nanographenes and Graphene Nanoribbons (through Collaboration 2.2)

While the conventional solution synthesis fails to afford highly insoluble and/or unstable compounds, the on-surface synthesis enables the visualization and investigation of such elusive products under the ultrahigh vacuum (UHV), based on the methods of surface science, especially scanning probe microscopy and scanning tunneling spectroscopy (STS) (cited from FY2022 Annual Report). In this fiscal year, we continued to work on the solution synthesis of novel molecular precursors for the on-surface synthesis experiments to be performed in the laboratories of our collaborators (Collaboration 2.2) while finalizing the interpretation and publication of previously obtained results. In particular, we reported the on-surface synthesis of novel edge-extended zigzag GNRs with fused anthracene and bisanthene units (*Precis. Chem.* **2024**, *2*, 81; *Adv. Mater.* **2023**, *35*, 2306311). Using 2,7-dibromo-9,9'-bianthryl as the precursor, the formation of anthracene-fused zigzag GNRs was achieved, which was accompanied by byproducts resulting from the cyclodehydrogenation in undesired conformation on the surface (*Precis. Chem.* **2024**, *2*, 81). Nonetheless, unique skeletal rearrangement was revealed for the formation of the byproducts, which could be explained by the intramolecular Diels–Alder cycloaddition. In contrast, when 2,7-dibromo-9,9':10',9"-teranthracene with an additional anthryl group was used as the precursor, the conformational isomerization on the surface could be suppressed by the enhanced steric hindrance, selectively providing bisanthene-fused zigzag GNRs (*Adv. Mater.* **2023**, *35*, 2306311). This GNR was theoretically predicted to possess magnetic properties with spin polarized edge-states, but experimental investigations by STS revealed its closed-shell properties on the Au(111) surface, which depopulated the spin-relevant states. Nevertheless, these results provided a new strategy to synthesize a wider variety of unprecedented edge-extended zigzag GNRs.

3.3 Water-Dispersible Polymer Nanoparticles Containing Nanographenes

The atomically precise GQDs and other functional PAHs are highly hydrophobic and typically insoluble in water, which hinders their bioimaging and other biomedical applications. Water-soluble GQDs can be obtained by installing hydrophilic substituents at the peripheral positions, but it requires additional synthetic steps and often tedious purification processes. To circumvent this problem, we have previously explored the encapsulation of double [7]helicene (D7H) as a hydrophobic PAH in amphiphilic polymers, and successfully obtained polymer nanoparticles containing D7H (D7H-NPs), which were well dispersed in water (cited from FY2021 Annual Report). In this fiscal year, we investigated water-dispersible polymeric nanoparticles containing triply fused porphyrin-nanographene conjugates with one or two π -extended hexa-*peri*-hexabenzocoronene units (NGP-NPs), displaying absorption extending to ~1000 and ~1400 nm in the NIR-I and NIR-II windows, respectively (*Adv. Sci.*, **2024**, *11*, 2309131). NGP-NPs exhibited high photothermal conversion efficiencies and promising photoacoustic responses, along with high photostability and biocompatibility, enabling photoacoustic imaging (PAI)-guided photothermal therapy (PTT). On the other hand, we provided D7H-NPs to Light-Matter Interactions for Quantum Technologies Unit at OIST for investigating the optical trapping of such polymeric nanoparticles containing nanographenes (arXiv:2404.17307).

4. Publications

4.1 Journals

4.1.1 Original Research Articles

1. H. Wu, [H. Hanayama](#), M. Coehlo, Y. Gu, Z.-H. Wu, S. Takebayashi, G. Jakob, S. Vasylevskyi, D. Schollmeyer, M. Kläui, G. Pieters, M. Baumgarten, K. Müllen,* [A. Narita](#),* Z. Qiu,* Stable π -Extended Thio[7]helicene-Based Diradical with Predominant Through-Space Spin–Spin Coupling. *J. Am. Chem. Soc.* **2024**, *146*, 7480–7486.
2. [H. Zhao](#), Y. Wang, Q. Chen, Y. Liu, Y. Gao, K. Müllen, S. Li,* [A. Narita](#),* A Nanographene-Porphyrin Hybrid for Near-Infrared-II Phototheranostics. *Adv. Sci.*, **2024**, *11*, 2309131.
3. M. Di Giovannantonio,* Z. Qiu, C. A. Pignedoli, [S. Asako](#), P. Ruffieux, K. Müllen,* [A. Narita](#),* R. Fasel,* On-surface cyclization of vinyl groups on poly-para-phenylene involving an unusual pentagon to hexagon transformation. *Nat. Commun.* **2024**, *15*, 1910.
4. J. Liu, J. Hong, Z. Liao, [J. Tan](#), H. Liu, E. Dmitrieva, L. Zhou, J. Ren, X.-Y. Cao, A. A. Popov, Y. Zou, A. Narita, Y. Hu, Negatively Curved Octagon-Incorporated Aza-nanographene and its Assembly with Fullerenes. *Angew. Chem. Int. Ed.* **2024**, *64*, e202400172.
5. [X. Xu](#),[#] A. Kinikar,[#] M. Di Giovannantonio, C. A. Pignedoli, P. Ruffieux, K. Müllen,* R. Fasel,* [A. Narita](#),* On-Surface Synthesis of Anthracene-Fused Zigzag Graphene Nanoribbons from 2,7-Dibromo-9,9'-bianthryl Reveals Unexpected Ring Rearrangements. *Precis. Chem.* **2024**, *2*, 81–87.
6. X. Zhu,[#] Q. Chen,[#] [H. Zhao](#),[#] Q. Yang, [Goudappagouda](#), M. Gelléri, S. Ritz, D. Ng, K. Koynov, S. H. Parekh, V. K. Chetty, B. K. Thakur, C. Cremer, K. Landfester, K. Müllen, M. Terenzio, M. Bonn,* [A. Narita](#),* X. Liu,* Intrinsic Burst-Blinking Nanographenes for Super-Resolution Bioimaging. *J. Am. Chem. Soc.* **2024**, *146*, 5195–5203. (Selected as the Cover)
7. [X. Xu](#), Q. Yang, [H. Zhao](#), S. Vasylevskyi, M. Bonn, X. Liu,* [A. Narita](#),* Chiral Nanographene-Based Near-Infrared Fluorophore with Self-Blinking Properties. *Adv. Funct. Mater.* **2024**, *34*, 2308110.
8. Q. Chen, M. Di Giovannantonio,* K. Eimre, J. I. Urgel, P. Ruffieux, C. A. Pignedoli, K. Müllen, R. Fasel,* [A. Narita](#),* On-Surface Interchain Coupling and Skeletal Rearrangement of Indenofluorene Polymers. *Macromol. Chem. Phys.* **2023**, *224*, 2300345. (Invited contribution to Special Issue: 80 Years of MCP: The Next Generation of Polymer Researchers)
9. A. Kinikar,[#] [X. Xu](#),[#] M. D. Giovannantonio, O. Gröning, K. Eimre, C. A. Pignedoli, K. Müllen, [A. Narita](#),* P. Ruffieux, R. Fasel,* On-Surface Synthesis of Edge-Extended Zigzag Graphene Nanoribbons. *Adv. Mater.* **2023**, *35*, 2306311.
10. X. Yao,* H. Zhang, F. Kong, A. Hinaut, R. Pawlak, M. Okuno, R. Graf, P. N. Horton, S. J. Coles, E. Meyer, L. Bogani, M. Bonn, H. I. Wang,* K. Müllen,* [A. Narita](#),* N=8 Armchair Graphene Nanoribbons: Solution Synthesis and High Charge Carrier Mobility. *Angew. Chem. Int. Ed.* **2023**, *62*, e202312610. (Highlighted in ChemistryViews)
11. M. Yang, [H. Hanayama](#), L. Fang, M. A. Addicoat, Y. Guo, R. Graf, K. Harano, J. Kikkawa, E. Jin,* [A. Narita](#),* K. Müllen,* Saturated Linkers in Two-Dimensional Covalent Organic Frameworks Boost Their Luminescence. *J. Am. Chem. Soc.* **2023**, *145*, 14417–14426.

12. S. Garcia-Orrit, V. Vega-Mayoral, Q. Chen, G. Serra, G. M. Paternò, E. Cánovas, A. Narita, K. Müllen, M. Tommasini, J. Cabanillas-González, Nanographene-Based Decoration as a Panchromatic Antenna for Metalloporphyrin Conjugates. *Small* **2023**, *19*, 2301596. (Selected as the Back Cover)

*Equal author contributions are indicated by #, corresponding authors are denoted by *, and unit members are underlined.*

4.2 Books and Other One-Time Publications

Nothing to report

4.3 Oral and Poster Presentations

Invited Talks at Conferences and Symposiums

1. A. Narita, "Synthesis of Molecular Nanographenes and Graphene Nanoribbons with Magnetic Properties" 8th International Conference on Superconductivity and Magnetism - "ICSM2023", Ölüdeniz-Fethiye/Muğla, Turkey, May 4–11, 2023
2. A. Narita, "Synthetic Exploration of Functional Nanographenes for Photonic Applications" 243rd ECS Meeting, Boston, MA, May 28–June 2, 2023
3. A. Narita, "Molecular Design and Chemical Synthesis of Carbon Nanomaterials" 2023 Japan-America Frontiers of Engineering Symposium, Waseda University, Tokyo, Japan, July 17–20, 2023
4. A. Narita, "Synthesis and Peripheral Functionalization of Highly Luminescent Polycyclic Aromatic Hydrocarbons" CEMS Topical Meeting on Chemistry of pi-Conjugated Materials, RIKEN, Wako, Japan, July 31–August 1, 2023
5. A. Narita, "Bottom-Up Synthesis of Atomically Precise Molecular Nanographenes and Graphene Nanoribbons with Magnetic Properties" The 65th Fullerenes-Nanotubes-Graphene General Symposium, Nishijin Plaza, Kyushu University, Fukuoka, Japan, September 4–6, 2023
6. A. Narita, "ナノグラフェンの精密合成と多彩な物性" 応用化学専攻談話会, Department of Applied Chemistry, The University of Tokyo, Japan, September 9, 2023
7. A. Narita, "次世代ナノカーボン材料の精密分子合成と多彩な物性" 第8回 研究講演会, 一般社団法人 持続社会発展のための機能化学研究委員会, Tokyo, Japan, October 10, 2023
8. A. Narita, "Synthesis and Functionalization of Atomically Precise Nanographenes toward Photonic Applications" 3rd International Symposium on Dynamic Exciton (ISDyEx), Mainz, Germany, November 27–28, 2023
9. A. Narita, "Synthesis of Atomically Precise Graphene Nanostructures and Modulation of Their Photophysical Properties" Echegoyen International Symposium (8th Intl. Symp. on Synthesis & Properties of Nanomaterials for Future Energy Demands), SIPS2023, Panama, November 27–December 1, 2023
10. A. Narita, "グラフェン量子ドットの精密合成と多彩な物性 (Precision Synthesis and Emerging Properties of Graphene Quantum Dots)" 第20回酸化グラフェン研究会, Matsuyama, Japan, December 8, 2023

Oral Presentations at Conferences and Symposiums

1. A. Narita, "Nanographenes as highly luminescent carbon nanomaterials " JST-OIST Joint Symposium on Circularly Polarized Luminescence and the Related Phenomena, OIST, Okinawa, Japan, April 15, 2023.
2. N. M. Bojanowski, "Bottom-up synthesis of oxygen-doped dibenzo[*hi,st*]ovalene" E-MRS 2023 Fall Meeting, European Materials Research Society (E-MRS), Warsaw, Poland, September 18–21, 2023
3. X. Xu, "Near-infrared emitting molecular nanographene materials" The 12th Chinese Chemical Society Organic Solid State Electronic Process and Chinese Symposium on Organic Optoelectronic Functional Materials, Changchun, China June 7–10, 2023.
4. A. Narita, "Molecular Synthesis and Functionalization of Atomically Precise Fluorescent Nanographenes" OIST-Kyudai Joint Symposium Series 1: Bio-Inspired Wonders and Energy Innovations, OIST, Okinawa, Japan, February 29, 2024

Poster Presentations at Conferences and Symposiums

1. H. Zhao, L. Guillaud, X. Xu, L. Zhou, Y. Hu, M. Terenzio, A. Narita, "Water-Soluble Nanoparticles with Fluorescent Nanocarbon Molecules" 2023 Japan-America Frontiers of Engineering Symposium, Waseda University, Tokyo, Japan, July 17–20, 2023
2. X. Xu, A. Narita, "Zigzag- and Fjord-Edged Nanographene with Near-Infrared Chiroptical Properties" The 14th Japan-China Joint Symposium on Conduction and Photoconduction in Organic Solids and Related Phenomena, Nagoya University, Nagoya, Japan, December 7–9, 2023
3. H. Zhao, A. Narita, "Water-Soluble Nanoparticles with Twisted Double[7]Carbohelicene for Lysosome-Targeted Cancer Photodynamic Therapy "The 14th Japan-China Joint Symposium on Conduction and Photoconduction in Organic Solids and Related Phenomena, Nagoya University, Nagoya, Japan, December 7–9, 2023
4. J. Tan, A. Narita, "Synthesis and Properties of a π -Extended Double [9]Helicene" The 14th Japan-China Joint Symposium on Conduction and Photoconduction in Organic Solids and Related Phenomena, Nagoya University, Nagoya, Japan, December 7–9, 2023
5. T. Onishi, A. Narita, "Self-assembly of nanographene with nitrogen-doped zigzag edges on Au(111) and its electronic properties" E-MRS 2023 Fall Meeting, European Materials Research Society (E-MRS), Warsaw, Poland, September 18–21, 2023
6. S. Raj, X. Xu, A. Narita, "Synthetic Approach Toward Functionalized Dibenzo[*hi,st*]ovalenes as Highly Stable and Emissive Nanographenes with Zigzag edges" 16th edition of the International Conference on Organic Electronics (ICOE2023), Madrid, Spain, July 3-7, 2023

Presenters are underlined.

Seminars

1. A. Narita, "Interplay Between Nanocarbon Synthesis and Molecular Spectroscopy" Department Retreat of Division Molecular Spectroscopy (Max Planck Institute for Polymer Research), Heidelberg, Germany, May 9, 2023
2. A. Narita, "Bottom-up Molecular Synthesis of Atomically Precise Graphene Quantum Dots," Politecnico di Torino, Torino, Italy, September 22, 2023

3. A. Narita "Bottom-Up Synthesis of Atomically Precise Graphene Nanostructures and Their Emerging Properties," IMDEA Nanoscience, Madrid, Spain, November 22, 2023
4. A. Narita, "ナノグラフェンの精密合成と多彩な物性" 第340回化学コロキウム, Tokyo Metropolitan University, Tokyo, Japan, December 15, 2023
5. A. Narita, "Bottom-up Molecular Synthesis of Atomically Precise Graphene Nanostructures and Their Emerging Properties," Università di Modena e Reggio Emilia, C.N.R.- Institute of nanoSciences S3, Modena, Italy, March 7, 2024

5. Intellectual Property Rights and Other Specific Achievements

- PCT (International) and Taiwan patent application with Qi Uint and Kabe Unit, Graphene-Like Conjugated Molecule as Hole Selective Contact for Operationally Stable Inverted Perovskite Solar Cells and Modules, 2024/02/27.
- Patent application together with Kabe Unit and Max Planck Institute for Polymer Research, Fluorescence recovery in nanographene, EP24165695.8, 2024/03/22.

6. Meetings and Events

6.1 Workshop

JST-OIST Joint Symposium on Circularly Polarized Luminescence and the Related Phenomena

Dates: 2023.4.14 to 2023-4-15; Venue: B250 (Sydney Brenner Hall)

Organizers:

- JST-CREST Research Group on "[Innovative optics and photonics] Creating innovative optics and photonics based on creative principles"
- Organic and Carbon Nanomaterials Unit, OIST

Speakers: Ms. Hiroyo Clemente (Office of the Dean of Research, OIST), Prof. Takashi Fujikado (Osaka University), Prof. Kazuo Akagi (Ritsumeikan University), Prof. Ryota Kabe (OIST), Prof. Yuuya Nagata (Hokkaido University), Prof. Julia Khusnutdinova (OIST), Ms. Satoko Suzuki (Osaka University), Prof. Akimitsu Narita (OIST)

6.2 Seminars by External Speakers

- Dr. Sobi Asako (RIKEN, Japan), "Organic Synthesis Using Abundant Resources" 2023-04-24, Venue: L4E48 (Lab 4)
- Dr. Marco Di Giovannantonio (Institute of Structure of Matter, CNR, Rome), "On-Surface Synthesis: What Happens Behind the Scenes?" 2023-04-25, Venue: L4E48 (Lab 4)
- Prof. Mathias Kläui (Institute of Physics, Johannes Gutenberg-University), "Antiferromagnetic Spintronics: Spintronics without magnetic fields" 2023-04-27, Venue: C210 (Center Building)
- Prof. Mathias Kläui (Institute of Physics, Johannes Gutenberg-University), "Charge and spin transport in 2D materials – from graphene nanoribbons to magnetic heterostructures" 2023-04-28, L4E48 (Lab 4)
- Prof. Shinya Hayami (Department of Chemistry, Kumamoto University), "Graphene Oxide as a Super Material" 2023-08-14, Venue: C700 (Lab 3)
- Prof. Mischa Bonn (Max Planck Institute for Polymer Research), "Water and Graphene: a Quaint Quantum Couple" 2023-08-16, Venue: L4E48 (Lab 4)
- Prof. Tomoko Shimizu (Keio University), "Scanning probe microscopy of technologically relevant nanomaterials -- How to overcome the "materials gap"--" 2023-09-26, Venue: L4E48 (Lab 4)

- Prof. Dennis Chung-Yang Huang (Hokkaido University), "Lighting up Functional Organic Chemistry" 2023-12-18, Venue: L4E48 (Lab 4)

7. Other

7.1 Grants and Fellowships

- Akimitsu Narita (PI), Japan Society for the Promotion of Science (JSPS) KAKENHI, Fund for the Promotion of Joint International Research (Home-Returning Researcher Development Research), らせん構造を有するナノグラフェンおよびグラフェンナノソレノイドの合成と物性評価, 19K24686, FY2020–FY2022 (extended to FY2023)
- Akimitsu Narita (PI), JSPS International Joint Research Program with German Research Foundation (JRP-LEAD with DFG), Development of Hybrid Single-Atom Photocatalysts based on Graphene Quantum Dots and 2D Materials Toward Solar Energy Conversion, JPJSJRP20221607, 12.2022–11.2025 (German PI: Prof. Bernd Smarsly, Justus Liebig University Giessen)
- Akimitsu Narita (Co-Investigator), JSPS KAKENHI, Fund for the Promotion of Joint International Research (Fostering Joint International Research (B)), 先端分光計測と精密合成を活用したグラフェンナノリボンの微細構造と機能の制御, 21KK0091, FY2021–FY2024 (PI: Prof. Masanari Okuno, The University of Tokyo)
- Akimitsu Narita (PI), JSPS Bilateral Joint Research Project with The National Research Council of Italy (CNR), Atomically precise carbon-based platforms for single-atom nanomaterials, JPJSBP120234004, FY2023–FY2024 (Italian PI: Dr. Marco Di Giovannantonio, Institute of Structure of Matter, CNR)
- Zakaria Ziadi (PI), JSPS KAKENHI, Grant-in-Aid for Scientific Research (C), Development of Nano Gas Sensors Based on Single Atomically Precise Graphene Nanoribbons, 23K04546, FY2023–FY2025
- Hao Zhao, JSPS Research Fellowship for Research in Japan (Standard) and Grant-in-Aid for JSPS Fellows, 超解像蛍光イメージングを志向した水溶性ナノグラフェンの合成, 23KF0075, FY2022–FY2024
- Niklas Maximilian Bojanowski, JSPS Research Fellowship for Research in Japan (Standard) and Grant-in-Aid for JSPS Fellows, Supramolecular Polycyclic Aromatic Hydrocarbons: Structure and Morphology in Self-Assemblies, 22KF0367, FY2022–FY2024 (terminated in FY2023)

7.2 Other Projects

- Participation as an extra-EU partner in the FET Proactive project LIGHT-CAP: Multi-electron processes for light driven electrodes and electrolytes in conversion and storage of solar energy, the European Consortium funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101017821, 2021-2024

7.3 External Contributions

- A. Narita, Speaker, New Career Path in Globalized Society ~Diversity in Career Path Choices~, Lecture Session Organized by Japan Society of Coordination Chemistry Diversity Committee (錯体化学会ダイバーシティ推進委員会主催講演 国際化社会における新しいキャリアパス ~進学の先にある多種多様な働き方~), Nisshin Plaza, Kyushu University & ONLINE, August 3, 2023
- A. Narita, Associate Editor, *Organic Materials*, Georg Thieme Verlag KG, Stuttgart (since January 2023)
- A. Narita, Member of the Early Career Advisory Board, *Asian Journal of Organic Chemistry*, Wiley-VCH GmbH, Weinheim (since January 2020)
- A. Narita, Co-organizer, B05 - Fullerenes - Endohedral Fullerenes and Molecular Carbon, the 243rd ECS Meeting, The Electrochemical Society (ECS), Boston, MA, May 28–June 2, 2023
- A. Narita, Symposium organizer, Exploring the potential of bidimensional materials for energy and optoelectronics, E-MRS 2023 Fall Meeting, European Materials Research Society (E-MRS), Warsaw, Poland from September 18 to 21, 2023

