Young Career Focus: Professor Akihito Konishi (Osaka University, Japan)

Background and Purpose. SYNFORM regularly meets young up-and-coming researchers who are performing exceptionally well in the arena of organic chemistry and related fields of research, in order to introduce them to the readership. This Young Career Focus presents Professor Akihito Konishi (Osaka University, Japan).

Biographical Sketch

Prof. A. Konishi

Akihito Konishi received his Ph.D. in 2013 from Osaka University (Japan) under the supervision of Prof. Takashi Kubo. In 2010, he spent three months with Prof. Rik R. Tykwinski as a visiting researcher at the University of Erlangen–Nuremberg in Germany. During 2014–2015, he worked as a high school teacher in Hyogo prefecture (Japan). After returning to Osaka University, he was appointed Assistant Professor at the Department of Applied Chemistry of Osaka University in 2015. He is currently interested in the synthesis and characterization of novel π-conjugated molecules. He is also investigating the development of Lewis acid catalyzed reactions using main group metals. His awards and honors include: 2020 Young Scholar Lectures of CSJ; 2023 Commendations for Science and Technology Young Scientists' Award in MEXT; 2023 Incentive Award in Synthetic Organic Chemistry; 2023 Chemist Award BCA of MSD Life Science Foundation, Public Interest Incorporated Foundation; and 2024 Thieme Chemistry Journals Award.

INTERVIEW

SYNFORM *Which field of organic chemistry are you interested in the most and why?*

Prof. A. Konishi My favorite field of organic chemistry is physical and structural organic chemistry, because a beautiful molecule showing an unusual reactivity and having a fascinating geometry always suggests an intrinsic feature of the chemical bond.

SYNFORM *Following that, what is the focus of your current research activity?*

Prof. A. Konishi My current curiosity is synthesizing and characterizing novel non-benzenoid hydrocarbons having anti-aromatic and open-shell characteristics (Figure 1). Especially, polycyclic hydrocarbons containing non-alternant hydrocarbons such as azulene, pentalene, and heptalene have been my synthetic targets. The related molecules have a long history, and abundant achievements have been demonstrated by many legendary pioneers. Still, many molecules remain elusive even though they should exhibit fascinating electronic features. Characterizing an unreachable molecule should open the door to exciting chemistry based on its molecular framework. Strong cooperation of experimental studies with theoretical investigations will elaborate on the above issues, and the interesting structural and electronic features of non-benzenoid hydrocarbons will attract much attention from various branches of chemistry.

SYNFORM *What do you think about the modern role and prospects of organic chemistry?*

Prof. A. Konishi That is a critical point in researching organic chemistry. I believe that organic chemistry can solve many global problems, such as climate change, food supply

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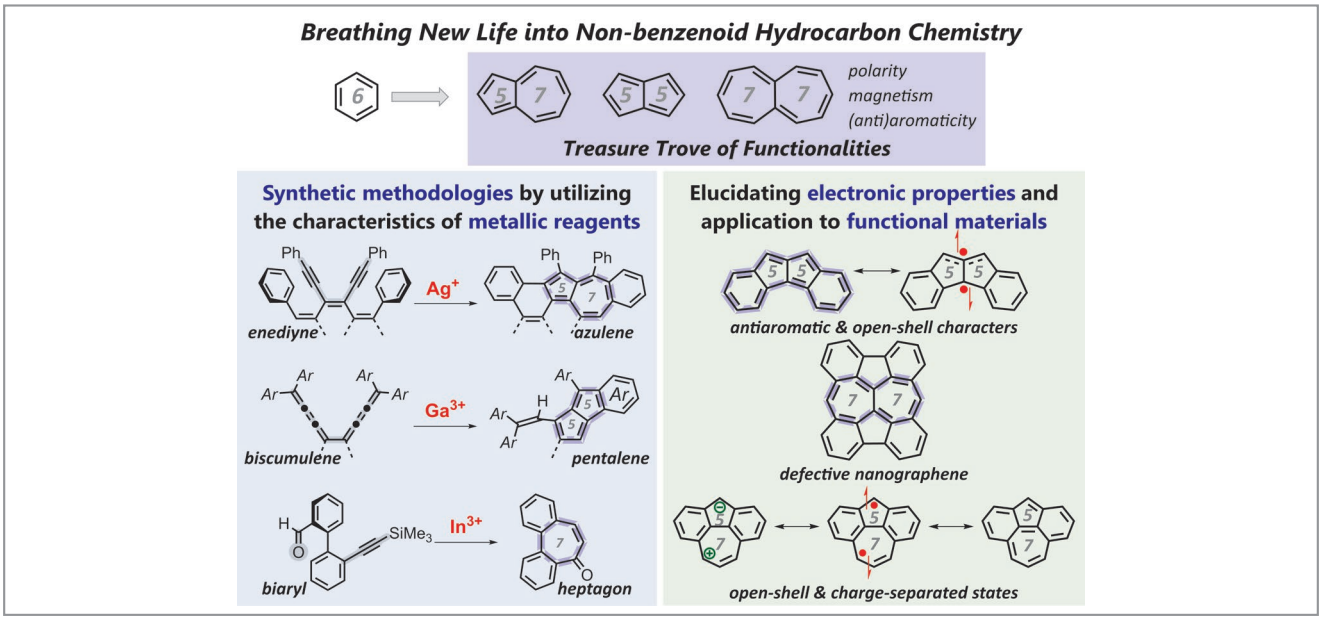

Figure 1 Summary of research interests

problems, depletion of petroleum resources, and so on. From the academic viewpoint, the balance between academic curiosities and awareness of social implementation is essential in order to enhance the possibilities offered by organic chemistry.

SYNFORM *Which difficulties are there for young upcoming chemists in your field? Do you have any tips?*

Prof. A. Konishi The decreasing number of academic positions and research funding is one of the most challenging points. As one tip to overcoming the situation, connections and exchanges among researchers are important.

SYNFORM *What is your most important scientific achievement to date and why?*

Prof. A. Konishi I would like to nominate two recent achievements. The first is the first synthesis and characterization of bis-periazulene (*J. Am. Chem. Soc.* **2022**, *144*, 3370). The pursuit of the non-alternant isomers of pyrene, which has seven possible non-alternant isomers, has been the most significant related project. Through enormous dedication by many pioneering works, six of the seven possible non-alternant isomers of pyrene have been isolated and characterized as stable aromatic molecules, differentiating themselves from pyrene in terms of optoelectronic properties. However, the only unsynthesized isomer, bis-periazulene (cyclohepta[*def*]fluorene), had remained an uncharacterized hydrocarbon until 2022, despite many synthetic and theoretical investigations since it was first reported in 1955. My group synthesized and characterized triaryl derivatives that exhibited the superimposed electronic structures of peripheral, polarized, and open-shell π-conjugated systems. In contrast to previous theoretical predictions, bis-periazulene derivatives were in the singlet ground state. Changing an aryl group controlled the energy gap between the lowest singlet–triplet states. My group unveiled that the double *peri*-benzoannulation into an azulene core provides fascinating electronic features.

The second is characterizing the pseudo Jahn–Teller effect (PJTE) of 4nπ-conjugated system (*J. Am. Chem. Soc.* **2023**, *145*, 20595). Although PJTE is an essential effect to provide the attractive characteristics of 4nπ systems, an understanding of the structure–property relationship derived from the PJTE for planar 4nπ electron systems is still in its infancy. Our experimental and theoretical investigations through diareno[*a*,*f*]pentalenes concluded that their largest anti-aromaticity and moderate open-shell character are derived from the small energy barrier $E_a^{\ddagger}$ for the bond-shift valence tautomerization. The energy profile of the single crystal of the molecule showed the temperature-dependent structural variations assigned to the dynamic mutual exchange between the two C_s-symmetric structures, which was also supported by the spectroscopic measurements in the solution phase. The find-

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ings of this study advance the understanding of antiaromaticity characterized by the PJTE by controlling the energy barrier for bond-shift valence tautomerizations, potentially leading to the rational design of optoelectronic devices based on novel antiaromatic molecules possessing the strong contributions of their highly symmetric geometries.

SYNFORM *Could you tell us something about yourself outside the lab, such as your hobbies or extra-work interests?*

Prof. A. Konishi I enjoy spending time with my family.

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