The Photopolymer Science and Technology Award

The Photopolymer Science and Technology Award No. 252200, the Best Paper Award 2025, was presented to Tomokazu Umeyama[a], Motohisa Kubota[b], Haoxuan Zhang[b], Rintaro Adachi[c], Akira Yamakata[c], Tomoyuki Koganezawa[d], and Hiroshi Imahori[b] ([a]University of Hyogo, [b]Kyoto University, [c]Okayama University, [d]Japan Synchrotron Radiation Research Institute) for their outstanding contribution published in Journal of Photopolymer Science and Technology, **37**, (2024) 197–204, entitled "Development of Non-Fullerene Acceptors with π-Extended Central Unit for Organic Photovoltaic Devices".

Tomokazu Umeyama

Tomokazu Umeyama received his BS (1999), MS (2001), and PhD (2004) in Polymer Chemistry from Kyoto University. Upon completing his doctoral degree, he joined the Department of Molecular Engineering, Graduate School of Engineering, Kyoto University, where he served as an Assistant Professor (2004–2013) and later as an Associate Professor (2013–2021). From 2010 to 2014, he was also a PRESTO researcher at the Japan Science and Technology Agency (JST). In 2021, he was appointed as a Professor at the Department of Applied Chemistry, Graduate School of Engineering, University of Hyogo. His research focuses on the development of organic semiconductors and nanoscale materials for photofunctional device applications.

Motohisa Kubota

Motohisa Kubota is a PhD student in the research group of Professor Imahori at the Department of Molecular Engineering, Graduate School of Engineering, Kyoto University. He received his Master Degree in Chemistry in 2023 from the University of Hyogo under the supervision of Professor Umeyama.

Haoxuan Zhang

Haoxuan Zhang is a PhD student in the research group of Professor Makoto Fujita at the Department of Applied Chemistry, Graduate School of Engineering, The University of Tokyo. He received his Master Degree in Chemistry in 2024 from Kyoto University under the supervision of Professor Imahori.

Rintaro Adachi

Rintaro Adachi is a master's student in the research group of Professor Yamakata at the Department of Environmental, Life, Natural Science and Technology, Graduate School of Environmental, Life, Natural Science and Technology, Okayama University. He received his Bachelor's Degree in Chemistry in 2024 from Okayama University under the supervision of Professor Yamakata.

Akira Yamakata

Akira Yamakata received his PhD (1999) in Chemistry from the Tokyo Institute of Technology. He worked as a postdoctoral researcher at the Kanagawa Academy of Science and Technology (KAST) before becoming an Assistant Professor at the Catalyst Research Center, Hokkaido University, in 2003. In 2010, he was promoted to Associate Professor at Toyota Technological Institute and was later appointed as a Professor at Okayama University in 2023. From 2011 to 2014, he also served as a PRESTO researcher at the Japan Science and Technology Agency (JST). His research focuses on developing advanced spectroscopic techniques for elucidating photocatalytic reaction mechanisms and improving organic solar cell technologies.

Tomoyuki Koganezawa

Tomoyuki Koganezawa is currently a senior scientist and team leader of Japan Synchrotron Radiation Research Institute (JASRI/SPring-8). He received his BS (1999), MS (2001), and PhD (2004) in Physics from Ritsumeikan University. He was a postdoctoral fellow at Ritsumeikan University from 2004 to 2005 and moved to JASRI/SPring-8 in 2005. He works as a beamline scientist for the X-ray diffraction/scattering beamline at the synchrotron radiation facility SPring-8.

Hiroshi Imahori

Hiroshi Imahori completed his doctorate in chemistry at Kyoto University. From 1990 to 1992, he was a postdoctoral fellow at the Salk Institute for Biological Studies, United States. In 1992, he became an Assistant Professor at ISIR, Osaka University. In 1999, he moved to the Graduate School of Engineering, Osaka University, as an Associate Professor. Since 2002, he has been a Professor of Chemistry at the Graduate School of Engineering, Kyoto University. He received the JSPS Prize (2006), the Osaka Science Prize (2007), the CSJ Award (2023), and the Medal with Purple Ribbon (2024). His current interests involve artificial photosynthesis, organic solar cells, and photofunctional materials.

Organic photovoltaics (OPVs) are considered one of the most promising photovoltaic technologies due to their unique features, including low cost, solution processability, lightweight, and mechanical flexibility [1–4]. Over the past decade, remarkable progress has been achieved in OPVs, largely attributed to the development of acceptor-donor-acceptor (A-D-A) type non-fullerene acceptors (NFAs) [5–7]. Typical A-D-A type NFAs consist of fused multi-ring ladder structures as the central donor (D) unit and 1,1-dicyanomethylene-3-indanone (IC) derivatives as the terminal acceptor (A) units. The central D unit not only acts as an electron-rich moiety to facilitate intramolecular charge transfer but also plays a crucial role in optimizing energy levels and molecular packing to enhance charge dissociation and transport.

Prof. Umeyama, Prof. Imahori, and their collaborators proposed that an effective strategy to improve the photovoltaic performance of A-D-A type NFAs is to expand the donor (D) π-core, thereby enhancing intermolecular interactions and improving molecular packing. For example, they achieved high power conversion efficiencies (PCEs) of 11–14% using a series of A-D-A type NFAs with a donor core comprising a naphthalene–bisthieno[3,2-*b*]thiophene fused structure [8,9]. Additionally, NFAs with a two-dimensionally expanded donor core, thienoazacoronene, exhibited unique characteristics, such as a long singlet exciton (S_1) lifetime (~1.6 ns) in films, in contrast to a short S_1 lifetime (220 ps) observed in solution [10–12].

In this article, they focused on the anthracene–bisthieno[3,2-*b*]thiophene fused structure (ATT) as the donor (D) core in A-D-A type NFAs for photovoltaic applications. To investigate the effects of the position and number of carbons in the non-aromatic fused rings connecting bisthieno[3,2-*b*]thiophene to anthracene, they designed and synthesized three different ATT-based NFAs, referred to as the ATTIC series. The ATTIC molecules share identical end groups and side chains but exhibit distinct solubility, light absorption properties, energy levels, and singlet exciton lifetimes. One of the ATTICs has low solubility in organic solvents, hindering the fabrication of OPV devices. OPV devices based on the other two NFAs, combined with a conjugated polymer donor J71, showed markedly different PCEs of 7.1% and 1.8%, respectively. This discrepancy is primarily attributed to differences in molecular packing structures within the blend films. These findings indicate that minor structural modifications in the π-extended central D core of A-D-A type NFAs significantly influence blend film morphology and photovoltaic performance. Therefore, the position and carbon number of non-aromatic fused rings in π-extended central unit should be carefully considered during the molecular design of NFAs.

These results were presented at the 41st International Conference of Photopolymer Science and Technology (ICPST-41) and published in the Journal of Photopolymer Science and Technology. These contributions represent a significant advancement in photopolymer science and technology, particularly in the field of OPVs.

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Itaru Osaka, Hiroshima University
Hideo Ohkita, Kyoto University