Molecular nanocarbon synthesis and beyond

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Our goal is the creation of super molecules, innovative functional molecules with significant properties and/or beautiful molecules. To this end, we have focused on catalyst-enabling synthetic chemistry with broad directions, including applications in molecular nanocarbons, pharmaceuticals, and plant/animal chemical biology, and the development of rapid molecule-assembly methods using unique catalysts. In particular, we have pioneered molecular nanocarbon science by the bottom-up synthesis of structurally uniform nanocarbons of fundamental and practical importance. Representative achievements include: (1) the development of single-step aromatic π-extension (APEX) methods for the rapid and programmable synthesis of nanocarbon molecules (*Nature Chem. 2015, Nature Commun. 2015, Science 2018, Nature Commun. 2021*); (2) the synthesis of carbon nanorings, nanobelts and pure nanotubes (*ACIE 2009, Nature Chem. 2013, Science 2017, Nature Commun. 2018, Nature Commun. 2019, Nature Chem. 2021, Nature Synth. 2022*); and (3) the synthesis of topologically unique nanocarbons such as warped nanographenes, carbon nanocages, all-benzene catenanes, trefoil knots, and infinitene (*Nature Chem. 2013, Science 2019, Nature Catal. 2020, JACS 2022*). This lecture will highlight our 17-year campaign in the synthesis and application of carbon nanorings/nanobelts and our programmable, diversity-oriented and growth-from-template synthesis methods for nanographenes based on annulative π-extension (APEX) concept as well as our exciting new endeavor trying to develop game-changing molecules for nanocarbon-based chemical biology and explore a new field of molecular nanocarbon biology.

Kenichiro Itami

Professor, Department of Chemistry, Nagoya University, Japan (since 2008)
Principal Investigator and Founding Director, Institute of Transformative Bio-Molecules (ITbM), Nagoya University, Japan (since 2012)
Research Fellow, Institute of Chemistry, Academia Sinica, Taiwan (since 2019)

Kenichiro Itami (b. 1971) studied chemistry at Kyoto University, Japan, and completed his PhD in 1998 with Prof. Yoshihiko Ito. After being Assistant Professor at Kyoto University, he moved to Nagoya University as an Associate Professor in 2005, where he was promoted to Full Professor in 2008. In 2012 he created the Institute of Transformative Bio-Molecules (ITbM) in Nagoya University, serving as the principal investigator (also the founding director until March 2022). During 2013-2020, he was the Research Director of JST-ERATO Itami Molecular Nanocarbon Project. Since 2019, he has also been the Research Fellow at the Institute of Chemistry, Academia Sinica, Taiwan.

The work of Ken Itami has centered on catalyst-enabling synthetic chemistry with broad directions including molecular nanocarbon materials, C-H activation catalysts, medicinal

chemistry, and chemical biology. The representative achievement is the creation of a range of structurally uniform nanocarbons of fundamental and practical importance by bottom-up chemical synthesis. Noteworthy achievements include: (1) the development of new reactions and catalysts for the rapid and programmable synthesis of nanocarbon molecules (*Nature Commun. 2022, Nature Commun. 2021, Nature Catal. 2020, Science 2018, Nature Commun. 2015*); (2) the synthesis of ultra-short carbon nanotubes such as carbon nanobelts and carbon nanorings (*Nature Commun. 2022, Nature Chem. 2021, Science 2017, Nature Chem. 2013*); and (3) the synthesis of topologically unique nanocarbons such as warped nanographenes, carbon nanocages, all-benzene catenanes, trefoil knots, and infinitene (*Nature Synth. 2022, JACS 2022, Science 2019, Nature Chem. 2013*).

Ken Itami received more than 40 awards and honors such as the Netherlands Scholar Award for Supramolecular Chemistry (2018), the Guthikonda Lecturer, Stanford University (2018), ICI Distinguished Lecturer, University of Calgary (2017), Arthur C. Cope Scholar Award, American Chemical Society (2015), and Swiss Chemical Society Lectureship Award (2015). He is recognized as Highly Cited Researchers (Clarivate Analytics) 5 years in a row since 2017, with an h-index of 82.

Publications, Patents, and Lectures

Selected as Highly Cited Researchers 2017, 2018, 2019, 2020, 2021, Clarivate Analytics
H-index: 82 (Web of Science, ResearcherID: B-5110-2011)
376 publications
>120 patent applications
>450 plenary/invited lectures since 2006

Editorial Board

2008~2011 *Canadian Journal of Chemistry* (Advisory Board)
2011~2017 *Organic & Biomolecular Chemistry*, RSC (Editorial Board)
2012~present *Beilstein Journal of Organic Chemistry* (Associate Editor)
2012~present *ChemCatChem* (International Advisory Board)
2013~present *Bulletin of the Chemical Society of Japan* (Senior Editor)
2013~present *Chemistry - An Asian Journal* (International Advisory Board)
2014~present *Advanced Synthesis & Catalysis* (Academic Advisory Board)
2015~present *The Chemical Record* (Editorial Board)
2015~present *Tetrahedron/Tetrahedron Letters* (Consulting Board of Editors)
2016~2018 *Accounts of Chemical Research* (Editorial Advisory Board)
2016~present *Chem*, *Cell Press* (Editorial Board)
2017~2020 *Angewandte Chemie* (International Advisory Board)
2019~present *ACS Central Science* (Editorial Advisory Board)
2021~present *Tetrahedron Chem* (Advisory Board)

Main-Group Strategy toward Emissive π-Electron Materials

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Incorporation of main group elements into π-conjugated skeletons is a powerful strategy to develop new optoelectronic organic materials with unusual properties. A representative design strategy is to make best use of orbital interactions between a π-conjugated skeleton and a main-group moiety. Conformational constraint often plays a crucial role to gain an optimal orbital interaction. In addition, this is also useful to gain high chemical stability.[1] Based on this strategy, we have so far synthesized various types of functional π-electron materials. In this presentation, we would like to report recent progress in this chemistry. Specifically, we will discuss the utilization of the Lewis acidity of the boron atom for gaining stimuli-responsive changes in fluorescence,[2] and designs of new core skeletons that furnish near-infrared emission.[3,4] We will also discuss the potential utilities of several main-group-based π-conjugated skeletons, furnishing red-shifted absorption and fluorescence properties as well as high photostability, for the advanced fluorescent bioimaging.[5]

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酰亚胺功能化的分子碳（Molecular Carbon Imides）

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分子碳是具有确定原子组成和化学结构的分子基纳米碳。从 2006 年开始，我们研究团队基于独特、多样性的核心稠环结构-莱啉（Rylene）酰亚胺经典单元，利用边缘串联稠合策略，构建了丰富的酰亚胺功能化的分子碳材料库，包括一维碳纳米带酰亚胺、二维纳米石墨烯酰亚胺以及跨维度分子碳酰亚胺等。这类分子基纳米碳家族的新成员，具有合成灵活、结构可定制、性能多样、加工性能和稳定性优异等特点，对结构的创新、新奇物理化学性质的探索以及新颖材料性能的挖掘具有重要意义。

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报告人简介

王朝晖，清华大学化学系教授，有机光电子与分子工程教育部重点实验室副主任。2006 年入选中国科学院“百人计划”，2010 年“百人计划”终期评估优秀，2012 年获国家杰出青年基金，2014 年获中国化学会－巴斯夫公司青年知识创新奖，2017 年入选万人计划科技创新领军人才。长期从事酰亚胺功能化分子碳的设计、合成和可控组装以及分子器件的研究工作，迄今在《化学研究评述》（Acc. Chem. Res.）、《美国化学会志》（J. Am. Chem. Soc.），《德国应用化学》（ Angew. Chem. Int. Ed.）等国际权威期刊上发表论文 200 余篇，在国际和国内学术会议上做邀请报告 150 多次。

有机光电功能材料:分子基础与生物应用

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报告人简介

王树，中国科学院化学研究所研究员。1994 于河北大学获学士学位， 1999 于北京大学获博士学位，1999－2001 中国科学院化学研究所博士后，2001－2004 美国加利福尼亚大学圣巴巴拉分校博士后。主要研究方向：功能有机共轭分子体系的设计、合成与生物传感应用,生物自组装体系构筑及其抗菌、抗肿瘤活性研究,生物电子以及化学生物学研究。在 *J. Am. Chem. Soc.*、*Angew. Chem. Int. Ed.*、*Adv. Mater.*、*Chem. Rev.*、*Acc. Chem. Res.*、*Chem. Soc. Rev.*、*Sci. Adv.*、*Nat. Commun.*、*Nat. Protocol.*、*Research*、*CCS Chem.*等期刊发表学术论文 300 余篇，申请/授权专利 40 余项。目前担任美国化学会 *ACS Applied Bio Materials* 期刊 Deputy Editor。