Development of Novel Catalytic Organic Transformations

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Education
1984 B.S. Hokkaido University
1990 Ph.D. Hokkaido University

Professional Employment
1988 JSPS Research Fellow
1988 Research Associate, Hokkaido University
1990 Assistant Professor, Hokkaido University
1994 Research Associate, Columbia University
1995 Lecturer, Kyoto University
1997 Professor, Nagoya City University
2000 Professor, Institute for Molecular Science
Professor, The Graduate University for Advanced Studies
2007 Research team leader, RIKEN
2014 Distinguished Professor, Three Georges University
2003 Research Project Leader, JST CREST Project (–2008)
2008 Research Project Leader, NEDO Project (–2012)
2011 Deputy Research Project Leader, JST CREST (–2016)
2014 Research Project Leader, JST ACCEL Project (–2019)

Awards
1991 Eisai Award, Synthetic Organic Chemistry
1998 The Pharmaceutical Society of Japan Award for Young Scientist
2007 The Chemical Society of Japan (CSJ) Award for Creative Work
2007 MEXT Ministerial Award for Green Sustainable Chemistry
2010 Inoue Prize for Science
2014 The Commendation for Science and Technology by the Minister of MEXT (Research Category)

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Keywords Transition Metal Catalysis, Green Chemistry, Photocatalysis

Our research interests lie in the development of catalytic reaction systems toward ideal SDGs-conscious (highly efficient, selective, green, safe, simple, *etc.*) organic molecular transformations. In particular, development of a wide variety of the heterogeneous in-water catalytic systems, continuous flow catalytic systems, and super active catalysts working at ppm-ppb loading levels, have been achieved. Furthermore, we have recently been studying on the novel photocatalysis where, for example, carbonyl groups underwent two successive single-electron reduction to generate carbinol anion species achieving electrophilic carbonyl substitution. Along this line, in 2024, we have developed a series of novel diazabenzacenaphthenium photocatalysts, denoted as ***N*-BAP**s, which promoted the unprecedented 4-electron photoreduction of esters to form the corresponding alcohols with visible LED light irradiation under aqueous conditions.

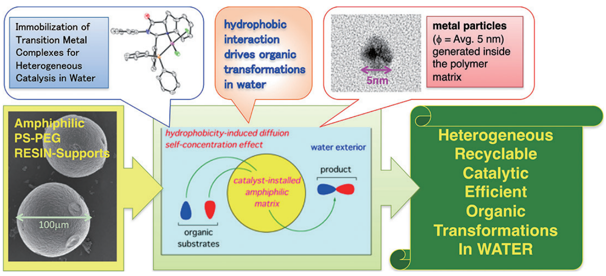


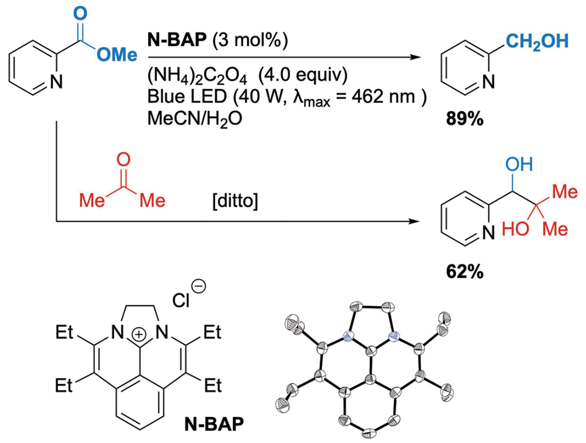
Figure 1. The typical concept of heterogeneous in-water catalyses using amphiphilic polymer-supported complex and nanoparticles catalysts.

Selected Publications

- S. Okumura, K. Torii and Y. Uozumi, "Electrophilic 1,4-Addition of Carbon Dioxide and Aldehydes to Enones," *Org. Lett.* **25**, 5226–5230 (2023).
- G. Hamasaka, D. Roy, A. Tazawa and Y. Uozumi, "Arylation of Terminal Alkynes by Aryl Iodides Catalyzed by a Parts-per-Million Loading of Palladium Acetate," *ACS Catal.* **9**, 11640–11646 (2019).
- T. Osako, K. Torii, S. Hirata and Y. Uozumi, "Chemoselective Continuous-Flow Hydrogenation of Aldehydes Catalyzed by Platinum Nanoparticles Dispersed in an Amphiphilic Resin," *ACS Catal.* **7**, 7371–7377 (2017).
- Y. M. A. Yamada, S. M. Sarkar and Y. Uozumi, "Self-Assembled Poly(imidazole-palladium): Highly Active, Reusable Catalyst at Parts per Million to Parts per Billion Levels," *J. Am. Chem. Soc.* **134**, 3190–3198 (2012).
- G. Hamasaka, T. Muto and Y. Uozumi, "Molecular-Architecture-Based Administration of Catalysis in Water: Self-Assembly of an Amphiphilic Palladium Pincer Complex," *Angew. Chem., Int. Ed.* **50**, 4876–4878 (2011).
- Y. Uozumi, Y. Matsuura, T. Arakawa and Y. M. A. Yamada, "Asymmetric Suzuki-Miyaura Coupling in Water with a Chiral Palladium Catalyst Supported on Amphiphilic Resin," *Angew. Chem., Int. Ed.* **48**, 2708–2710 (2009).

1. Multielectron-Reduction with a Novel Photocatalyst *N*-BAP[1)]

In 2024, we have developed a novel diazabenzacenaphthenium photocatalyst ***N*-BAP** which was designed with a view to its use as a photocatalyst under visible-light irradiation in photoinduced multielectron-transfer reactions. Indeed, under visible-light irradiation, ***N*-BAP** promoted the four-electron reduction of esters, via the carbinol anion intermediates, to give the corresponding alcohols.[1a)] The intermediates, carbinol anions, also underwent a 1,2-addition to a second carbonyl compound, affording unsymmetric 1,2-diols. Furthermore, the ***N*-BAP**-catalyzed multielectron reduction is now applied to a variety of carbonyl compounds extensively.[1b)]



Scheme 1. Photocatalytic Reduction of Methyl Picolinate.

2. Silver-Mediated Homocoupling of Arylboronic Acids[2)]

We collaborated with Prof. Ohtaka's group at Osaka Institute of Technology to develop a homocoupling of arylboronic acids to form the corresponding biaryls. The coupling reaction proceeded with a catalytic amount of silver carbonate, where silver nanoparticles were generated to promote the reaction.

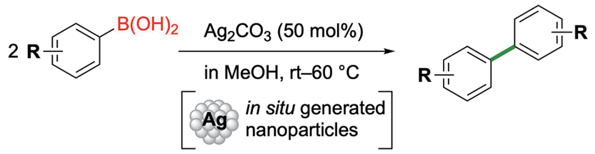
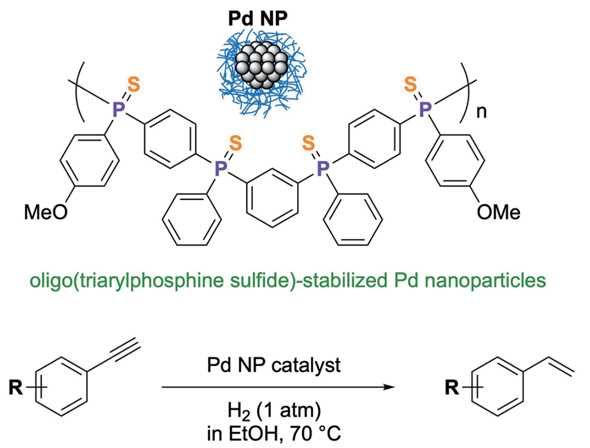


Figure 2.

TEM examination of the reaction mixture revealed that silver nanoparticles were generated in situ under the reaction conditions which should promoted the homocoupling reaction.

3. Oligo(Triarylphosphine Sulfide)s-Stabilized Pd Nanoparticles for Controlled Hydrogenation of Terminal Aryl Alkynes[3)]

In the development of high-performance metal nanoparticle (NP) catalysts, the exploration of new classes of multidentate organic stabilizers is crucial. Prof. Ohta and his co-workers at Ehime University and we have developed a series of structurally diverse oligo(triarylphosphine sulfide)s through the Pd-catalyzed P–C cross-coupling reactions of hydroxymethylphosphine sulfide derivatives with aryl halides. The oligomers were employed as stabilizing agents for Pd NP catalysts. These catalysts were characterized by TEM, EDS, and ICP-MS analyses to determine the average Pd particle size and the constituent elements on the catalyst. We evaluated their catalytic activity in the semihydrogenation of phenylacetylene to styrene in EtOH at 70 °C for 3 h under atmospheric pressure of H_2 with a catalyst loading of 0.5 mol% Pd. It was revealed that Pd NPs stabilized with oligo(triarylphosphine sulfide)s, featuring a high number of coordination sites and a combination of p-phenylene and m-phenylene linkers, exhibited high selectivity for styrene and low Pd leaching.



Scheme 2. Synthesis of oligo(triarylphosphine sulfide)s.

References

1) (a) S. Okumura, S. Hattori, L. Fang and Y. Uozumi, *J. Am. Chem. Soc.* **146**, 16990–16995 (2024). (b) Unpublished results.

2) T. Sakaguchi, K. Fukuoka, T. Matsuki, M. Kawase, A. Tazawa, Y. Uozumi, Y. Matsumura, O. Shimomura and A. Ohtaka, *Synlett* **36**, 161–165 (2025).

3) H. Ohta, H. Goda, H. Fujinaga, Y. Suenaga, K. Kanbara, A. Tazawa, G. Hamasaka, Y. Uozumi and M. Hayashi, *Asian J. Org. Chem.* **14**, e00361 (2025). DOI: 10.1002/ajoc.202500361