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2010 : January 2010 - New Hot Papers : Yoshinori Yamamoto on Synthetic Chemistry

new hot papers - 2010

January 2010



Yoshinori Yamamoto talks with *ScienceWatch.com* and answers a few questions about this month's New Hot Paper in the field of Chemistry.



Article Title: Coinage metal-assisted synthesis of heterocycles

Authors: Patil, NT; Yamamoto, Y

Journal: CHEM REV, Volume: 108, Issue: 8, Page: 3395-3442, Year: AUG 2008

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SW: Why do you think your paper is highly cited?

Heterocycle synthesis is extremely important to the pharmaceutical industry and also to the material sciences, in some parts, because most drugs contain heterocyclic structures. For example, rather old medicines such as penicillin and vitamins, and the more recently successful drug Viagra, contain heterocyclic structures. Accordingly, not only chemists in academia, but also those in industry are interested in new synthetic methods for heterocyclic compounds.

In addition to the importance of the compounds and structures themselves, "coinage metal-catalyzed (assisted) reactions" are a newer methodology in the field of synthetic chemistry. It had been believed that Au, Ag, (and Pt) are expensive metals and synthetic chemists have not been familiar with the reagents/catalysts derived from those noble metals.

However, entirely new molecular transformations have been discovered using those noble metals as catalysts. This is another reason why this article is a highly cited paper; not only practical industrial researchers, but also pure chemists in academia have had an interest in this paper and also in this research field.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

Yes, as I mentioned above, entirely new molecular transformations have been discovered in this research field, which had previously not been possible through the use of previously known synthetic methodologies.

"...even catalytic reactions, after everything is done, have to be thrown away—especially in the case of homogeneous molecular catalysts. This is not a green process!"

SW: Would you summarize the significance of your paper in layman's terms?

Coinage metals (Au, Ag, and Cu) and other noble metals, such as Pt, attract particular interest from synthetic organic chemists, because those metals become useful catalysts for synthesizing the core structures of many important drugs.

Most drugs have heterocyclic structures and those structures can be synthesized readily and quickly by their coinage metals-catalyzed molecular transformations, i. e., carbocycles and heterocycles; cyclic compounds made by only carbon atoms (C) are called carbocycles. Cyclic compounds made by heteroatoms—such as N, O, and S—and carbon atoms are called heterocycles.

SW: How did you become involved in this research, and were there any particular problems encountered along the way?

For many years, I have been involved in the research of metal-catalyzed reactions, but at the beginning of my career, coinage metals (except Cu) and noble metals had never been included in the general materials of chemists, primarily because of their expense and the fact that almost no investigations using noble metals had been done in the past. However, about 10 years ago, one of my students used an Au complex in testing some reactions. I hadn't told him to use it and I was not even aware that he had used it.

Later on, I realized that this unexpected use of an Au complex induced a very interesting molecular transformation. This was the starting point for my entering this research field. The only problem, even at that time, was that people believed that coinage metals were too expensive to utilize in this process, but it is not true, as Pd and Rh are nowadays even more expensive.

SW: Where do you see your research leading in the future?

I regularly examine leading journals such as *Nature*, *Science*, and the more specialized *JACS/Angew. Chem.*, in order to be made aware of which direction the most timely and important investigations are headed. With my own strong background in the field, I can thereby direct and handle my research based on the latest findings.

SW: Do you foresee any social or political implications for your research?

This is an important task for scientists. Nowadays, social and political implications (or influence) of our own research is becoming increasingly important to us, and we have to adapt our thinking to this requirement. For my own research, catalytic reactions are quite important when compared to stoichiometric reactions, because of the waste problems and energy savings.

However, even catalytic reactions, after everything is done, have to be thrown away—especially in the case of homogeneous molecular catalysts. This is not a green process! Nowadays, to undertake a solution to the environmental problem, we will have to create a catalyst for a greener process. This will be my next research target.

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KEYWORDS: DIELS-ALDER REACTIONS; GOLD-CATALYZED CYCLIZATION; TRANSFER RADICAL CYCLIZATION; HIGHLY EFFICIENT SYNTHESIS; 1,3-DIPOLAR CYCLOADDITION REACTIONS; NONSTABILIZED AZOMETHINE YLIDES; C-C-BOND; GOLD(I)-CATALYZED INTRAMOLECULAR HYDROAMINATION; COPPER(I)-CATALYZED 3-COMPONENT REACTION; ENANTIOSELECTIVE 3+2 CYCLOADDITION.

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