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2009 : July 2009 - New Hot Papers : Norbert Krause

NEW HOT PAPERS - 2009

July 2009


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



Article Title: Golden opportunities in stereoselective catalysis

Authors: Bongers, N;Krause, N

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

The use of gold is currently at the center of interest in transition metal catalysis. It is the unique ability of gold catalysts to selectively activate carbon-carbon double and triple bonds in the presence of many other functional groups which makes it highly valuable for the synthesis of complex target molecules. Despite these advantages, applications of gold catalysis in stereoselective synthesis are still rare. The paper highlights the first examples for highly stereoselective gold-catalyzed transformations, a field that is very "hot" right now.

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

The widespread use of gold as a catalyst for the synthesis of fine chemicals, natural products, and pharmaceuticals began just 10 years ago. Hence, stereoselective transformations are also very new, compared to other, well-established transition metals like palladium. In stereoselective gold catalysis, both traditional methods (chirality transfer, enantioselective synthesis) and new concepts like the use of chiral anions show much promise.

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

The review article focuses on stereoselective gold-catalyzed transformations, i.e., reactions that allow for the selective synthesis of one enantiomer of a chiral molecule. Enantiomers are the image and mirror image of a molecule that cannot be superimposed. The selective synthesis of enantiomers is particularly important for pharmaceuticals since the human organism often interacts differently with image and mirror image. One has the desired pharmacological activity, whereas the other is inactive, or even harmful. A nice comparison is the human hand: a right glove does only fit to the right hand, not to the left. A well-known example of this difference is the drug thalidomide: one enantiomer is acting as a tranquilizer whereas its mirror image

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causes birth defects.

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

We started using gold catalysts for cyclization reactions of functionalized allenes 10 years ago and are particularly interested in the chirality transfer from the starting material to the product. Selectivity and reactivity are the main issues in all transition metal-catalyzed reactions. Fortunately, both problems can be solved in gold catalysis by a "fine-tuning" of the catalyst, using different ligands and solvents. We have applied our cyclization reactions to the stereoselective synthesis of various natural products and/or pharmaceutically active compounds possessing chiral five- or six-membered heterocyclic rings.

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

In the near future, we will focus our research on the development of new gold catalysts for their application in complex chemical and biological systems. Towards this end, stability, reactivity, and selectivity have to be improved. This requires the synthesis of new, unconventional ligands for the gold catalyst which should also allow for its recyclability.

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

Nowadays, it is highly important to improve the sustainability of chemical processes. In the ideal chemical reaction, all atoms of the starting material(s) are transferred into the product(s), and no hazardous waste is formed. In the real world, most reactions suffer from the extensive use of energy, reagents, and/or toxic solvents (which remain as waste).

In this respect, catalytic transformations are preferable, since they use only small amounts of catalysts which might be recyclable. Thus, performing catalytic reactions with environmentally friendly solvents and purification methods at room temperature is highly desirable. I am convinced that gold catalysis will be an important tool for the development of these sustainable processes.

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