Young Career Focus: Dr. Nitin T. Patil (CSIR – National Chemical Laboratory, India)

Background and Purpose. From time to time SYNFORM meets young up-and-coming researchers who are performing exceptionally well in the arena of organic chemistry and related fields of research, in order to introduce them to the readership. This Young Career Focus presents Dr. Nitin T. Patil (CSIR – National Chemical Laboratory, India).

Biographical Sketch

Dr. N. T. Patil

Nitin T. Patil completed his doctoral studies at the University of Pune (India) in 2002 under the supervision of Professor D. D. Dhavale. After working as a postdoc at the University of Göttingen (Germany) with Professor Christoph Schneider, he moved to Tohoku University (Japan) as a JSPS fellow. In April 2005, he was appointed as Assistant Professor in Professor Yoshinori Yamamoto's laboratory. In June 2006, he joined Professor K. C. Nicolaou's Chemical Synthesis Laboratory@Biopolis in Singapore, moving later to The Scripps Research Institute (USA). He began his independent career in September 2008 at IICT, Hyderabad (India). In August 2013, he moved to CSIR-NCL, Pune (India). He was the recipient of the INSA Young Scientist Medal (2010) and the Alkyl Amines-ICT Foundation Day Young Scientist Award (2010). He was also elected as 'Young Associate' of the Indian Academy of Sciences, Bangalore, in 2010.

INTERVIEW

SYNFORM *What is the focus of your current research activity?*

Dr. N. T. Patil The development of catalytic cascade reactions by integrating multiple catalytic cycles in one pot is of prime importance in organic chemistry. The reaction, catalyzed by two different catalysts at the same time, can provide access to reactivity and selectivity not otherwise possible by a single catalyst alone. Unlike biological processes, where nature takes advantage of enzyme architecture to facilitate a multiple reaction manifold, it is difficult to exploit such processes in a flask because of obvious compatibility issues. The main focus of our research is to merge metal- and organocatalysis to develop novel synthetic methods which are otherwise impossible to realize by a single catalyst alone.

SYNFORM *When did you get interested in synthesis?*

Dr. N. T. Patil Since childhood, I have been always curious to know how nature creates molecules, though I was too immature to understand the chemistry of living systems. It was only during school/college days that I became familiar with nature's way of synthesizing molecules. In a real sense, I got interested in synthesis when I joined Professor Dhavale's laboratory for my Ph.D. studies. Further experience in the development of catalytic methods in Professor Schneider's and Professor Yamamoto's laboratories and total synthesis in Professor Nicolaou's laboratory triggered my interest to work in organic synthesis. This is the reason why I embarked on my independent career and chose to challenge myself with organic synthesis.

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SYNFORM *What do you think about the modern role and prospects of organic synthesis?*

Dr. N. T. Patil The field of synthetic organic chemistry has evolved considerably since Wöhler discovered the synthesis of urea – the first organic molecule synthesized in the laboratory. Undoubtedly, modern life without organic molecules is difficult to imagine, as they have found extensive applications not only in healthcare but also in agrochemicals, materials science, etc. However, the field of organic synthesis faces some problems – it is considered a traditional branch of science. Moreover, organic chemists communicate in the language of formulas, which is often not understood by non-experts and bureaucrats. While it is true that the most interesting challenges for organic chemistry will be derived from interdisciplinary fields, it does not mean that the field of organic synthesis will start to decline soon. Many new types of reactivities of fundamental interest have yet to be discovered, which would enable designed organic molecules to be obtained in an elegant and efficient manner. It is our belief that the field of organic synthesis will continue to flourish and would be considered as matured only when there exist techniques to make designed organic molecules in buckets (rather than flasks!).

SYNFORM *Your research group is active in the areas of organic synthesis and stereoselective catalysis. Could you tell us more about your research and its aims?*

Dr. N. T. Patil Our research work mainly focuses on the field of 'gold catalysis' and 'merging gold catalysis with organocatalysis' for developing newer methods in Diversity Oriented Synthesis (DOS) amenable for accessing natural-product-like molecules. In recent years, the branching cascade, considered as one of the forms of DOS, has gained much interest because of its potential to transform a common type of substrate into diverse and distinct molecular frameworks under the influence of either different reagents or different reaction conditions. However, there was no precedence of a catalytic branching cascade that generates large scaffold diversity despite the fact that scaffold diversity is very important to populate chemical space efficiently. Recently, our group developed relay[1] catalytic branching cascades (RCBC) – a new technique for accessing scaffold diversity.[2] The reaction of common starting materials (alkynes **A**) with variables (scaffold building agents **B**) under gold catalysis produces a series of multifunctional skeletally different polyheterocyclic scaffolds **AB** in an efficient manner (Figure 1).

We are also working on merged organo/gold catalysis – the technique wherein gold catalysts and organocatalysts exist in one pot. This chemistry is supposed to be interesting for Au(I) catalysis, given the difficulty of transferring chiral information from a ligand disposed 180° from the substrate. The phenomenon of merging gold catalysts with organocatalysts is quite remarkable as now there are many ways to access enantiopure products by varying chiral organocatalysts. Our

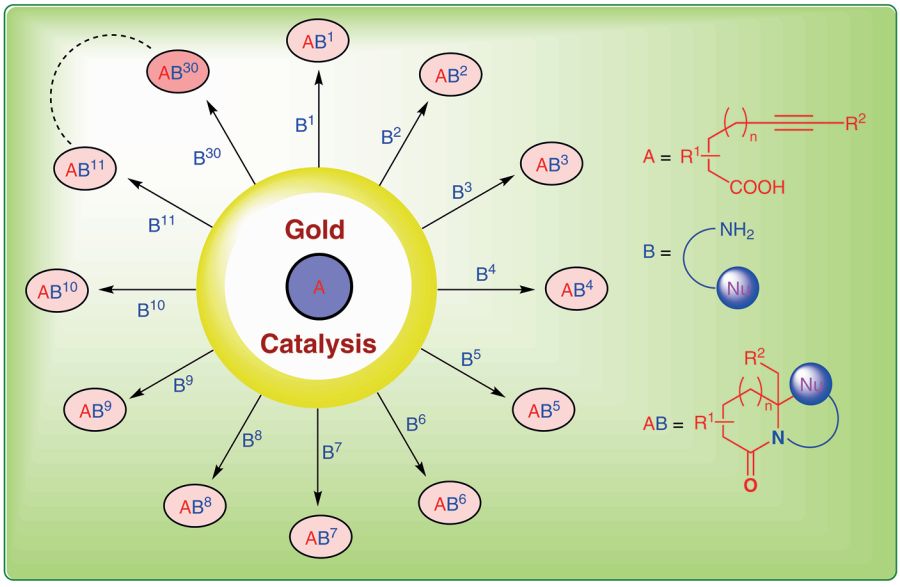

Figure 1 Relay catalytic branching cascade

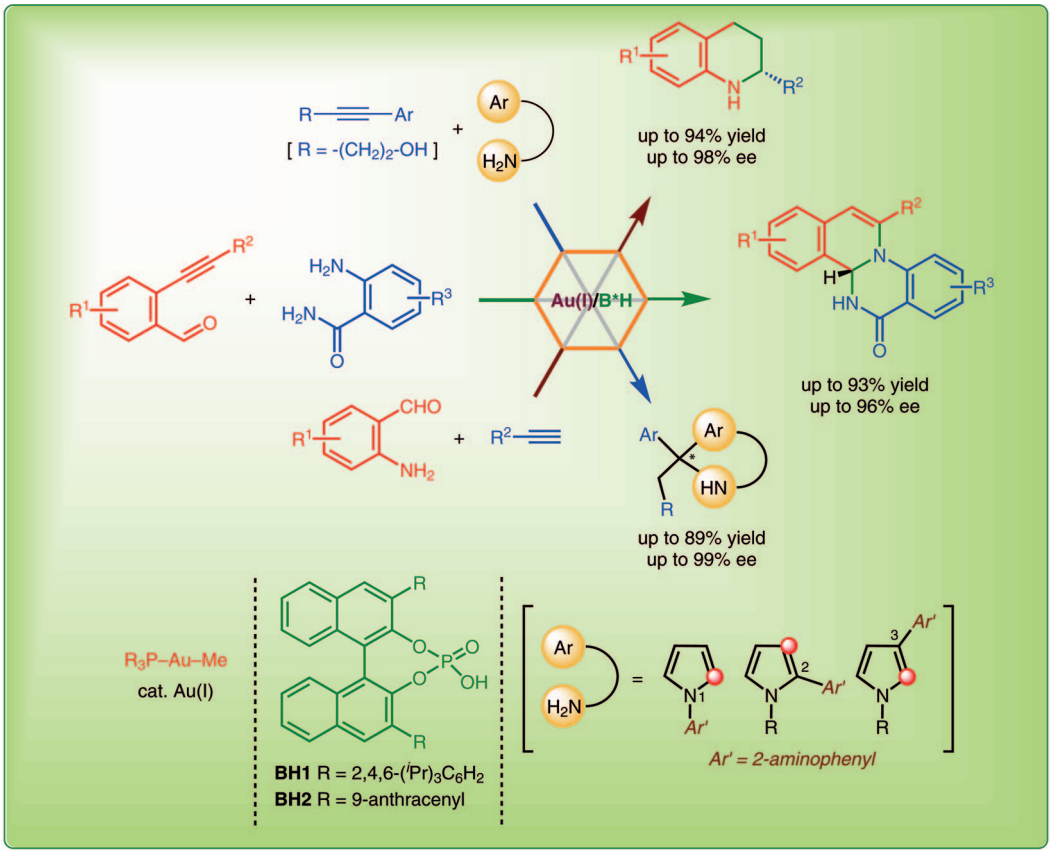

Figure 2 Enantioselective catalysis utilizing merged organo/gold catalysis

research in this area, based on gold and chiral Brønsted acid, led to some of the most important aspects and salient features of our activities, highlighted in Figure 2.[3]

SYNFORM *What is your most important scientific achievement to date and why?*

Dr. N. T. Patil It's really tough to answer this question as I stand at the foundation of my independent research career. However, if I were pressed, I would say that the ongoing research of my group is very exciting. We have developed the relay catalytic branching cascade (RCBC) as a new technique to access a series of multifunctional polyheterocyclic scaffolds.[2] This is the first report wherein we have shown that the catalytic branching cascade strategy generates a large scaffold diversity. In addition, we showed that merged organo/gold catalysis is a very important technique for accessing enantiopure heterocyclic scaffolds. This technique is supposed to be appealing as a number of imino/alkyne-based substrates could be easily envisaged.

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