Japan Academy Prize to:

Keisuke SUZUKI
Professor, Graduate School of Science and Engineering, Tokyo Institute of Technology

For “Studies on Synthesis of Complex Natural Products”

Outline of the work:

Synthetic organic chemistry is a scientific discipline, enabling access to useful organic compounds from easily available starting materials, where the molecular complexity is made increased through elaboration of the carbon framework and the functional groups. It is important not only as a basic science, but also as the technological background for providing new functional molecules to various related scientific fields, such as biosciences and materials science.

Prof. Keisuke Suzuki is one of the international leaders in organic synthesis with a significant contribution to the area of total synthesis of complex natural products and development of new synthetic reactions. By ingenious use of reactive species, he developed various new stereoselective processes to construct complex molecular architectures. His synthetic studies directed toward the challenging targets with stereochemical and functional complexities have culminated in various total syntheses of biologically active natural products, including glycoconjugates, antibiotics and polycyclic compounds. These achievements are based on the finding of unique solutions to a variety of issues emerged along the lines.

(1) Stereoselective reactions based on molecular rearrangements

One of the keys to organic synthesis is selective construction of the carbon-based molecular frameworks with precise control of three-dimensional structures. Prof. Suzuki developed useful strategies to address these problems based on 1,2-anionotropic reactions. Contrary to the traditional belief that such processes suffer from stereochemical deterioration, he showed that the Lewis acid-mediated 1,2-shifts proceed in stereospecific manner, which was applied to the asymmetric syntheses of chiral pheromones and macrolide antibiotics. He exploited organometallic complexes and heterocycles to enable the stereoselective construction of quaternary chiral centers via 1,2-rearrangements with full stereochemical integrity, which was utilized for the total synthesis of some antibiotic compounds.

(2) Synthesis of glycoconjugates and new glycosylation reactions

In view of the significant roles of the carbohydrate partial structures in various bioactive organic compounds, Prof. Suzuki carried out extensive studies on carbohydrate synthesis and developed new synthetic methods that have been exploited in total synthesis. He developed an efficient O-glycosylation reaction by using cationic hafnium complexes for activating glycosyl fluoride, which was used in the total synthesis of macrolide antibiotics. This unique reaction method has found many applications in oligosaccharide synthesis relevant to the cell biology research. He led the chemical synthesis of the aryl C-glycoside antibiotics, an emerging class of compounds since 1970. Among others, he developed a bio-inspired reaction (O→C glycoside rearrangement), which has been utilized by many researchers and this reaction allowed him to achieve the total syntheses of several antitumor antibiotics, including gilvacarcin and saptomycin.
(3) Synthesis of polycyclic compounds

Prof. Suzuki studied the synthesis of various complex polycyclic compounds derived from the type II polyketide biosynthesis, a rich source of biologically active molecules. These compounds feature multiple stereogenic centers and oxygen functionalities and have been regarded as a class of highly challenging targets in chemical synthesis. However, he developed an efficient method for assembling polycyclic structures based on rapid generation of benzyne species and an excellent synthetic planning. For the stereoselective assembly of polycycles, he developed stereocontrolled pinacol and benzoin cyclizations. His recent study has been also directed to the catechin-class polyphenols. In spite of the wide distribution in nature, these compounds have been regarded as inaccessible in scientific research by the difficulties in handling. However, he developed facile methods for the selective preparation of catechin monomers and the oligomers, opening a newer phase in the polyphenol research.

In summary, Prof. Suzuki carried out an extensive research on organic synthesis with particular emphasis on the total synthesis of biologically active natural products, posing significant impacts to related areas including biosciences and materials sciences. Awards and honors he has received include Synthetic Organic Chemical Society, Japan Award (2003), MEXT Award (2009), Humboldt Research Award (2009), Medal with Purple Ribbon (2010). He was a President of the Synthetic Organic Chemical Society, Japan (2013–2015).

Selected publications


