Tsutomu Katsuki

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Professor Tsutomu Katsuki died on October 30, 2014, at the age of 68. His research career focused largely on asymmetric oxidation using metal complexes as catalysts. Taking inspiration from nature, he was motivated to achieve high catalytic efficiency with complete stereo- and enantioselectivity, using molecular oxygen as oxidant. These goals continue to animate the field, with Katsuki's contributions serving as examples to many.

Katsuki was born on September 23, 1946 in Saga, Kyushu (Japan). He was an undergraduate and graduate student at Kyushu University, Fukuoka, receiving his PhD degree in 1976 under the direction of Professor Masaru Yamaguchi. During this time, he contributed to the development of the Yamaguchi esterification, which has become a standard reaction in the synthesis of macrolactones and highly functionalized esters. In 1979, Katsuki joined K. Barry Sharpless at Stanford University as a postdoctoral research associate, beginning his adventures in the use of metal catalysis for olefin oxidation with ruthenium tetraoxide as oxidizing agent. On January 18, 1980, he combined a tartrate diester, a titanium tetraalkoxide, *tert*-butylhydroperoxide, and a racemic allylic alcohol, and found that the reaction slowed down dramatically halfway through. A less discerning chemist might have dismissed this observation as a reaction gone wrong, but the careful and perceptive Katsuki realized its unusual nature. The result was the discovery of the asymmetric epoxidation (AE) reaction of allylic alcohols, the uniformly high enantioselectivity of which caused an immediate sensation in the chemical community, and led to the awarding of the 2001 Nobel Prize in Chemistry to Sharpless. Those days were recognized by Katsuki as the most exciting of his life. A myriad of synthetic applications of this reaction arose in the next few months, including the kinetic resolution of racemic secondary allylic alcohols and the synthesis of chiral natural products such as disparlure and sugar alcohols that had previously been unapproachable in enantioselective fashion.

In 1981, Katsuki returned as a research associate to Kyushu University, where he rose to full professor in 1988. In 2011, he received the signal honor of being named University Professor at Kyushu, and in 2012 he joined the International Institute on Carbon-Neutral Energy Research (I2CNER), also located at Kyushu, as World Premier Institute Principal Investigator.

Except for occasional work in total synthesis and the exploration of organic and metallic catalysts for other reactions, Katsuki focused much of his efforts on the asymmetric epoxidation of nonfunctionalized olefins. His laboratory was among the first to describe the type of chiral (salen)manganese(III) catalysts in common use today, bearing stereogenic centers in the diamine moiety and bulky and chiral substituents in the aromatic component. These systems provide high enantiomeric excess using several oxidants with substrates containing a wide variety of functional groups. Katsuki's incisive mechanistic work on oxidations based on salen metal complexes was accompanied by his development of other enantioselective processes using these catalysts, including cyclopropanation, Baeyer–Villiger rearrangement, hetero-Diels–Alder cycloaddition, sulfoxidation, aziridination, and *meso*-diol desymmetrization reactions.

One of Katsuki's key goals was the development of oxidizing catalysts using air. In 2000, he published a seminal report of oxidative kinetic resolution of secondary alcohols with air at room temperature under visible-light irradiation in the presence of [(ON)Ru(salen)] complexes. Later, he extended the use of O_2 to a series of important reactions such as coupling of 2-naphthols to enantiomeric binaphthols, dearomatization of 2-naphthols with construction of chiral quaternary stereocenters, and sulfide oxidation.

Tsutomu Katsuki's scholarly and scientific contributions are described in more than 300 papers that have had great impact in the chemistry community. He was honored with numerous awards and prizes, among them the Inoue Science Award (1996), the Synthetic Organic Chemistry Award, Japan (1998), the Chemical Society of Japan Award (2002), and the Ryoji Noyori Prize (2005).

Katsuki's personal contributions and influence were also profound to those who had the good fortune to know him. He considered himself first and foremost a teacher; his favorite way to start any scientific argument was "I am not sure". This was invariably followed by a large amount of data and carefully reasoned personal remarks. The depth and breadth of knowledge of this extremely friendly and unassuming man was often astounding. While it is certainly true that we scientists stand on the shoulders of giants, few of those shoulders have belonged to more gentle and delightful pioneers than Tsutomu Katsuki.

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