4th GSC Encouragement Award

Development of Novel Oxidation Catalyst Systems Using Designer Iodine Catalysis

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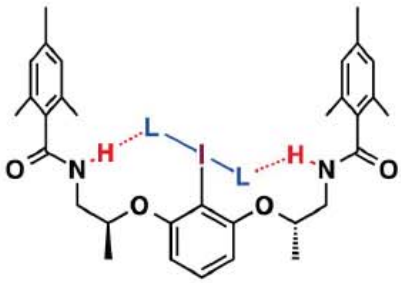
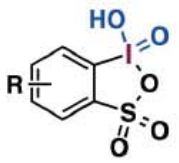
The use of rare transition metals and toxic heavy metals should be avoided as much as possible in the synthesis of medicinal and pharmaceutical products. Over the past three decades, hypervalent organoiodines have been the focus of great attention due to their mild and chemoselective oxidizing properties and their environmentally benign characteristics in contrast to toxic metal oxidants. Furthermore, the development of asymmetric redox organocatalysis is much more difficult than that of acid-base organocatalysis.

Hypoiodite Catalysts
(with H_2O_2 or ROOH)
Oxidative Coupling



Hypervalent Iodine(III) Catalysts
(with *m*-CPBA)
Oxidative Dearomatization



Hypervalent Iodine(V) Catalysts
(with Oxone)
Alcohol Oxidation

Our research group has been interested in the development of organocatalysis based on iodine chemistry since 2007. We have developed chiral hypoiodite catalysis for enantioselective oxidative coupling reactions, chiral hypervalent organoiodine(III) catalysis for enantioselective oxidative dearomatization reactions, and hypervalent organoiodine(V) catalysis for highly efficient and selective oxidation of alcohols and phenols. The most important features of these catalytic systems are: (1) metal-free oxidation, (2) milder reaction conditions, (3) high chemoselectivity (they tolerate a wide range of various functional groups), and (4) operational simplicity.

These results highlight the substantial scope of the catalysis using iodine species in place of transition metal catalysts. We anticipate that these findings will greatly contribute to green and sustainable chemistry.