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Total Synthesis of Natural Products, Development of Catalytic Methodologies, and Design of Novel Organocatalysis

In the field of organic synthesis, art and science are manifested in making molecules. As synthetic chemists, we aim for ideality in the way molecules are made. From strategy formulation, through execution, to obtaining the target compound, each stage demands an understanding of reactivity and selectivity in order for us to reach the ideality of synthesis. Economic aspects of overall processes also need to be evaluated wherein the application of catalysis and cascade sequences are obviously advantageous. Beyond efficiency and economy aspects, target molecules to be synthesized should be selected based on practical importance. Therefore, knowledge and material generated from research endeavor can not only expand the frontier of science, but also directly improve the well-being of mankind as a whole. Motivated by the considerations above, my research program is devoted to two primary areas: (I) Synthetic studies toward medicinally significant natural products, and (II) New strategies in asymmetric organocatalysis.

Small molecule natural products play a leading role in the arena of drug discovery. However, natural products of promising bioactivity are often difficult to access thus limiting their further biomedical investigations and commercialization as drug. Our laboratories aim to present creative, practical synthesis of biologically active natural products in enantioenriched form. Selected targets possessing notable pharmaceutical potentials include pibocin B, strictamine, mersicarpine, xiamycin A, and taiwaniaquinoids. The common theme of our synthetic strategy entails application of novel cascade reaction sequences, pericyclic reactions, and asymmetric catalysis. On the other hand, single enantiomer drugs constitute over half of the total drug market in the pharmaceutical industry. Partly driven by this need, laboratories around the world have devoted their efforts to the asymmetric synthesis of chiral small molecules. In respond to the increasing demands of asymmetric methodologies, we will also initiate programs in design and synthesis of chiral organic molecules that are capable of promoting reactions of fundamental interests. Overall, the investigations proposed are expected to impact the fields of total synthesis and asymmetric catalysis.