New systems for organocatalytic asymmetric epoxidation

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The development of methods for the introduction of asymmetry into organic molecules remains a topic of great importance. Catalytic systems are particularly desirable, and the combination of a catalytic asymmetric process with an environmentally friendly reaction system and an inexpensive oxidant offers an especially attractive goal. Non-racemic chiral epoxides are important intermediates for enantioselective carbon-carbon bond formation. We are developing organocatalytic systems in which asymmetric oxidants are formed by reaction of iminium salts with simple oxidants under mild conditions. We currently formulate the reactive intermediates as oxaziridinium ions, from which the iminium salt mediators are regenerated following oxygen transfer to alkene substrates. We can accomplish epoxidation of simple alkenes with up to ca 99% ee. Catalyst loading may be as low as 0.1 mol%. The epoxidation reactions may be carried out under aqueous or non-aqueous conditions. The iminium salt mediators can be easily prepared without chromatography in many cases, and the procedures used are simple to carry out, and require no preparation of unstable reagents. The lecture will discuss recent developments including new generations of catalyst, the first examples of kinetic resolution, the use of non-aqueous as well as the usual aqueous conditions, and alternative oxidants in place of Oxone, including hydrogen peroxide, bleach, and even electrochemical conditions by oxidant generation at boron-doped diamond electrodes.

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Fast electro-optic modulator in crystalline organic semiconductor nanowires

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The electro-optic modulation, with feasibility of low voltage control between microscopic electrodes, is a crucial route to manipulate the flow of light in nanophotonic circuits. Moreover, the versatile and facile operation brought by monolithic integration of electronics and optics will promote the multiple applications of electrically driven optical elements in the large-scale integrated photonic circuits. In most of these electro-optic systems, excitons are utilized as intermediate media to place the electronic operations on photons, because the electric field can distort the exciton wave function and modifies the photon-exciton interaction. In this regard, efficient interaction between exciton and electric field is in great demand in designing and realizing optimizing functional electro-optic modulators. Owing to the large intermolecular interactions in the organic nanocavities, the molecular excitation can be delocalized to the adjacent molecule units, bringing big electron cloud and therefore large electric field induced polarization. Moreover, frenkel type excitons in organic semiconductors possess a high binding energy (on the order of eV) and have strong coupling strength with photons, promoting the photon manipulation through the implementation of electric operations on the excitons. Herein, nanowire of organic π-conjugated compound 9,10-bis(phenylethynyl)anthracene (BPEA) was adopted due to its efficient excitonic coupling, high emission efficiency and low optical loss. Electro-optic modulators has been achieved and the light out-coupling intensity is tuned by applying electric field. This modulation is based on the electric effects on excitons, which enables to realize fast electro-optic switch under a nanosecond electric pulse generator.

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