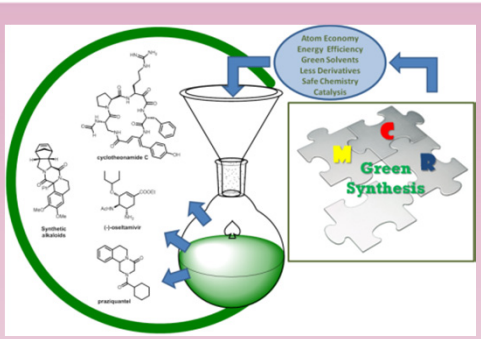
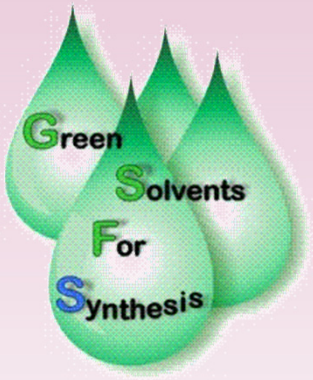
Towards Developing Green and Environmentally-benign Synthesis



http://syborch.com/razvan-c-cioc/

Green Solvents For Synthesis



http://dechema.de/gsfs2004.html

Green Chemistry

Green chemistry involves designing new synthetic strategies to reduce and avoid the use or synthesis of chemicals which may be toxic to the environment. The twelve principles of green chemistry focus on waste prevention, atom economy, and catalysis. In addition, while designing synthetic routes, care should be taken to minimize the use of protecting groups which may require separate steps for their removal. Safer solvents and auxiliaries, rather than organic solvents, should be considered. More importantly, increasing energy efficiency by other alternative sources of energy should be contemplated. Use of renewable feedstocks derivable from non-petrochemical-based materials is of importance.

Our research program has implemented and applied the principles of green chemistry towards developing green and environmentally benign synthesis. This can be broadly divided into two areas of designing new chemistries which are more environmentally friendly with fewer impacts on the environment. In addition, the use of newly developed or designed catalysts in novel transformations is highly encouraged. On the other hand, emphasis has also been put on the utilization of these green synthesis towards medicinal targets.

http://www.dmschemical.com/

Designing and Developing Novel Green Chemistry

With the use of subcritical water, which behaves as organic-like solvent, and a copper (I) complex as catalysts, we were able to effect the carbon-oxygen as well as carbon-nitrogen bond formations under closed system with higher pressure while using microwave as the source of energy. In addition, copper (0) powder could be employed in conjunction with the copper (I) complex to facilitate the carbon-carbon bond formation of the aromatic systems to provide the corresponding biaryls as the product. Moreover, water has been used to assist the cyclization reactions to furnish various heterocyclic systems containing oxygen and nitrogen such as isoxazoles and isoxazolines.

Applications of Green Synthesis Towards the Desired Targets

Principles of green chemistry have been successfully utilized to prepare lamellarins and their derivatives. Three reagents (bromine, bicarbonate, and acid) on solid supports derived from styrene polymers were employed in three different steps, thereby replacing the use of the corresponding conventional reagents. Since only simple filtration was required during the purification steps, the use of these solid-supported reagents helped reduce the amount of chemical wastes. In addition, our developed green synthesis of lactone and lactam moiety could be directly employed for the C-O and C-N bond formation respectively for the lamellarins and azalamellarins including benzopyranones.

Acid immobilized on silica has also been successfully employed to mediate the generation of quinone methides which underwent smooth cyclization with styrene derivatives to furnish the corresponding chromans in good yields and stereocontrol. Moreover, platinum(IV) salts could be used as catalyst for the similar reactions. Currently, these reactions have been successfully applied in the preparation of some complex chroman cores of natural products such as those in the palodesangrens.

In addition, the acid immobilized on silica as well as bismuth(III) complex could be effectively utilized as mediator/catalyst to prepare the diarylmethane core. For example, GC-1 is a diarylmethane derivative designed specifically to mimic the thyroid hormone with selectivity to bind with the thyroid receptor β over the α subtype. Our developed synthesis could prepare GC-1 in higher yields and fewer steps when compared with others.

http://climateinc.org/2012/01/green-chemistry-and-clean-energy/