Green Chemical Synthesis

Inventor
Dr. Wei Wang is an Associate Professor of Chemistry and Organic Chemistry in UNM’s Department of Chemistry. Wei received a BS from Nanjing Normal University (1988), a MS from Shanghai Institute of Materia Medica (1993) and a Ph.D. degree in Chemistry from North Carolina State University (2000). Research interests include Synthetic Organic Chemistry, Chemical Biology, Green Chemistry, and Molecular Recognition.

Problem
Over the past several decades, the main body of research in catalysis has been focused on transition metal-based organometallic catalysts. Over the years, however, relatively few asymmetric transformations have been reported which employ organic molecules as reaction catalysts (organocatalysts) despite their enormous potential and widespread availability in optically pure forms. Of the various methods available for the preparation of enantiomerically pure compounds, asymmetric catalytic processes are the most attractive because of the economic importance of such molecules. While the field is progressing rapidly, many challenges remain in asymmetric catalysis. Developing highly active catalysts that feature broad substrate scope and that can function under mild and simple reaction conditions remains a critical issue. Additionally, it is desirable to develop reactions based on readily available starting materials and reagents utilizing environmentally benign chemical processes.

Solution
We have developed metal free, ‘green,’ small molecule-based catalysts (e.g., organo-catalysts) which represents a new direction in asymmetric organic synthesis. These catalysts present a significant proprietary advantage in reducing the cost and improving the quality of pharmaceutical supplies (2004-040). In addition, elegant synthetic schemes for several pharmaceutically significant classes of compounds have been developed including:

2004-040: Metal Free Organo-Catalysts for Stereo-selective Aldol and Mannich Reactions
A new class of universal organocatalysts for the synthesis of single-enantiomer compounds that can facilitate a variety of enantiomeric selective reactions including Aldol condensations, Mannich reactions, Michael additions, Diels-Alder and other cycloaddition reactions alpha-aminations, alpha-aminoxylations and Friedel-Crafts alkylation reactions. These catalysts present a significant proprietary advantage in reducing the cost and improving the quality of pharmaceutical supplies.

2006-006: Organocatalytic Asymmetric Michael Addition Reactions
Novel catalysts were developed to use “Green Chemistry” (environmentally friendly) methodologies to prepare optically pure, enantioselective products. These catalysts are used to synthesize beta amino acids and amino ketones which are important building blocks in drug discovery and biological applications.

Market Opportunity
Our catalysts afford distinguishable benefits:
- Easily prepared, more environmentally benign and cheaper as they do not rely on expensive/toxic metals
- Reactions can be performed under an aerobic condition in common, even water-containing organic solvents
- More robust and can be stored and handled in an air atmosphere, thus providing operational simplicity
- Can be immobilized on a solid support and reused more conveniently than organometallic/bioorganic analogues

Consequently, they show promising adaptability to high-throughput screening and process chemistry. Other advantages associated with the use of organocatalysts, especially compared with enzymes and other bioorganic catalysts, are that they are more stable and less expensive and that they are capable of catalyzing a variety of organic reactions with a diverse range of different substrates. Such catalysts can provide high levels of asymmetric induction across a broad spectrum of chemical processes.