Chemists devise better way to prepare workhorse molecules

June 9 2011, by Terry Devitt

In chemistry, so-called aromatic molecules compose a large and versatile family of chemical compounds that are the stuff of pharmaceuticals, electronic materials and consumer products ranging from sunscreen to plastic soda bottles.

Writing in the current online issue (June 9) of the journal *Science*, a team led by University of Wisconsin-Madison chemistry Professor Shannon Stahl reports a new, environmentally friendly way to make substituted aromatic molecules that can be customized for different industrial needs.

As college chemistry students know, aromatic molecules have a special stability conferred by a ring of six carbon atoms with alternating single and double bonds. "The ultimate utility of these molecules depends on the chemical groups attached at the corners of this hexagonal platform," explains Stahl. "Interest in preparing substituted aromatic molecules traces back to the dawn of organic chemistry."

In fact, the 2010 Nobel Prize in Chemistry was awarded for catalytic chemical reactions that allow the introduction of specific groups to the periphery of aromatic molecules. These methods, and older traditional methods, rely on modifying an existing aromatic molecule, Stahl explains. But the stability of aromatic molecules can make such approaches difficult, and existing methods also have many limitations in the types and patterns of chemical groups that can be installed.

The method devised by Stahl and Wisconsin colleagues Yusuke Izawa and Doris Pun owes its success to the discovery of a new palladium catalyst. The catalyst gives chemists a way to peel off hydrogen from cyclic molecules to form aromatic products with the desired substitution patterns already in place. The hydrogen removed by the palladium catalyst is combined with oxygen, and water is formed as the only byproduct.

The Wisconsin team demonstrated the utility and efficiency of the new process on phenols, aromatic compounds that are produced on a large scale as precursors to many kinds of industrial materials and pharmaceutical agents. While the new catalytic method can be used to make a broad spectrum of aromatic molecules of interest to science and industry, the new work will be of most immediate practical use to drug companies, according to Stahl. For example, an anticancer agent that was difficult to make using previously known methods was efficiently produced using the strategy devised by the team.

Stahl notes that the work published today in *Science* will require more development before it is suitable for large-scale industrial production, but he emphasizes that concepts introduced by the new work will have broad utility. "Many new catalysts, reaction conditions and target molecules can be envisioned. Overall, this route to substituted aromatic molecules has a lot of potential," he says.

Provided by University of Wisconsin-Madison