Materials & Chemicals

Selective Conversion of Lignin into Simple Aromatic Compounds

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method to oxidize lignin or lignin subunits with high efficiency and selectivity.

Overview

Lignin is a major component of non-edible biomass (15-30 percent by weight; 40 percent by energy). It is a cheap byproduct of pulp and biofuel production and is one of the few naturally occurring sources of high-volume aromatic compounds. Converting lignin's complex biopolymer structure into simple organic chemicals attracts substantial interest.

For example, the world's supply of artificial vanillin is produced by oxidizing spent sulfite liquor. However, this requires a chemical feedstock that arises from an expensive and polluting sulfite pulping process used in very few mills today. Other methods consume energy or are not suitable on an industrial scale. Also, reactions can be explosive.

All such methods suffer from safety and environmental concerns, as well as lack of structural specificity when starting from raw lignin. Clearly, better ways to chemically transform lignin are needed.

The Invention

UW–Madison researchers have developed a metal-free, aerobic oxidation method that selectively transforms the benzylic alcohol in lignin to the corresponding ketone. The process uses a nitric acid (HNO_3) catalyst combined with another Brønsted acid. The reaction leaves unchanged at least a portion of unprotected primary aliphatic alcohols in the lignin or lignin subunit.

The reaction may be carried out in any suitable polar solvent and in the presence of additional reagents including TEMPO and derivatives.

Applications

- First step in the conversion of lignin to valuable aromatic fine chemicals

Key Benefits

- Strong reactivity and selectivity
- No expensive catalysts
- Potential for high yield

Additional Information

For More Information About the Inventors

- Shannon Stahl

Publications

- Rahimi A., Azarpira A., Kim H., Ralph J. and Stahl S. S. 2013. Chemoselective Metal-Free Aerobic Alcohol Oxidation in Lignin. J. Am. Chem. Soc. 135, 6415–6418.

Tech Fields

- Clean Technology : Biobased & renewable chemicals & fuels
- Materials & Chemicals : Synthesis

For current licensing status, please contact Jennifer Gottwald at jennifer@warf.org or 608-960-9854