Green Method for Producing 1,5-Pentanediol Slashes Catalyst Cost 10,000-fold

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a new route for producing the high value chemical 1,5-PD via upgrading of biomass-derived tetrahydrofurfuryl alcohol.

OVERVIEW

Commercial interest in the production of commodity chemicals from renewable sources continues to surge. Among these chemicals, α,ω-diols are particularly attractive because of the high market prices they command ($2,700 – 6,000/MT in 2015 U.S. dollars).

1,5-Pentanediol (I,5-PD), which is used as a plasticizer and also as a precursor in the manufacture of polyurethanes, is especially lucrative because it is currently produced in small quantities from petroleum feedstocks. Research has shown that 1,5-PD can be made from the conversion of tetrahydrofurfuryl alcohol (THFA) using noble metal catalysts. However, subprime yields, high temperature and reliance on high cost catalysts render the process economically infeasible.

THE INVENTION

Seeking a commercially viable alternative, UW–Madison researchers have developed a new route for producing 1,5-PD from biomass-derived THFA. Their three-step process is orders of magnitude cheaper than competing methods, green and exceeds 90 percent overall yields.

More specifically the new method includes hydration of THFA to dihydropyran, conversion to 2-hydroxy-tetrahydropyran (no need for a mineral acid catalyst) and subsequent production of 1,5-PD. The entire method can be conducted entirely in the absence of noble metal catalysts.

BUSINESS OPPORTUNITY

THE WARF ADVANTAGE

Since its founding in 1925 as the patenting and licensing organization for the University of Wisconsin-Madison, WARF has been working with business and industry to transform university research into products that benefit society. WARF intellectual property managers and licensing staff members are leaders in the field of university-based technology transfer. They are familiar with the intricacies of patenting, have worked with researchers in relevant disciplines, understand industries and markets, and have negotiated innovative licensing strategies to meet the individual needs of business clients.

The new method yields 1,5-PD at a catalyst cost that is roughly 10,000-fold less than that of the conventional THFA hydrogenolysis route. The researchers estimate that 1,5-PD can be produced via the present method at production costs of less than $1,000 per ton (excluding furfural feedstock costs).

APPLICATIONS

- Production of 1,5-PD for use in coatings, polymer resins, plasticizers, acrylates, adhesives and more

KEY BENEFITS

- New route is cheaper, faster and simpler than competing methods.
- Competes on price with petroleum-derived sources
- Uses inexpensive metal-oxide and base metal catalysts
- Relatively mild reaction conditions
- Higher reactant concentrations cut distillation costs.
- Eliminates difficult and costly acid neutralization step
- Incurs far lower separation costs

STAGE OF DEVELOPMENT

The new method results in >90 percent overall yield for conversion of furfural into 1,5 pentanediol.

The development of this technology was supported by WARF Accelerator. WARF Accelerator selects WARF's most commercially promising technologies and provides expert assistance and funding to enable achievement of commercially significant milestones. WARF believes that these technologies are especially attractive opportunities for licensing.

ADDITIONAL INFORMATION

Related Portfolios

WARF Accelerator Program Technologies

Publications

Brentzel Z.J., Barnett K.J., Huang K., Maravelias C.T., Dumesic J.A. and Huber G.W. 2017. Chemicals from Biomass: Combining Ring-Opening Tautomerization and Hydrogenation Reactions to Produce 1,5-Pentanediol from Furfural. ChemSusChem. 10, 1351-1355.

Read a news story about this technology.

Tech Fields

Clean Technology - Bio-based & renewable chemicals

CONTACT INFORMATION

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