Environmentally friendly catalysis of carbon double bond cleavage of cycloalkenes

Market Sectors: Chemicals, Catalyst.

Type of Opportunity: Leiden University is seeking commercial partners for licensing

Researchers at Leiden University have developed a very effective catalysis method for the cleavage of carbon double bonds at ambient temperatures and with aqueous H_2O_2 as oxidant.

The peroxidation of cycloalkenes results in a range of commercially interesting compounds, such as adipic acid, glutaric acid, butanetetracarboxylic acid, suberic acid and biphenylcarboxylic acid. Currently used methods involve organic solvents and produce nitrous oxide as waste product. Due to increasing environmental awareness the need for alternate 'clean' methods of peroxidation are rising.

However current 'clean' methods with peroxide as oxidant require high temperatures to achieve high efficiencies and as a result are not cost effective. The new effective biphasic catalytic system involving readily available and inexpensive catalytic precursors, namely tungsten-based salts, a commercial phase-transfer catalyst and a cheap, commercially available activator for the catalyst has been developed for an organic solvent free direct oxidation of cycloalkenes to dicarboxylic acids using 30% hydrogen peroxide as terminal oxidant.

Stage of development

The method had been fully tested to prepare adipic acid which can then be produced at room temperature with 99% efficiency (reaction time 4 hours) with zero nitrous oxide (N_2O) emissions. This method has been tested successfully using different substrates (producing glutaric acid, butanetetracarboxylic acid, suberic acid and biphenylcarboxylic acid), reaching efficiencies comparable to current 'dirty' production methods.

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Key Benefits

- Low-cost reactants and the readily available
- Re-use of the aqueous phase (catalyst solution) is possible with newly added H_2O_2, without loss of catalytic activity
- Procedure without organic solvents and no nitrous oxide as waste product
- More effective and faster oxidation of Cyclohexene at lower temperature (40 ºC instead of 90 ºC) when compared to currently available methods (using peroxide)
- Effectiveness of oxidation of other poorly reactive substrates is also greatly improved: substrates known as poorly reactive, like cyclooctene and phenanthrene, can also be oxidized
- one-pot synthesis of dicarboxylic acids directly from the corresponding cycloalkenes

Applications

- Production of carboxylic acids from alkenes

Patent status

- For this invention a patent application has been filed.

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