# High Yield Synthesis of Bio-based Acrylic Acid and Acrylate Monomers from Lactic Acid (20180106, Dr. Marc Hillmyer)

IP Status: Issued US Patent; Application #: 16/270,351

## **Catalytic Hydroesterification of Alkyl Lactates Provides Quantitative Yields**

A new, sustainable method synthesizes acrylic acid and acrylate esters starting from alkyl lactates. The method reacts alkyl lactate with carbon monoxide and ethylene in presence of a palladium catalyst, resulting in catalytic hydroesterification of the alkyl lactates yields alkyl 2-(propionyloxy)propanoates. Pyrolysis of the alkyl 2-(propionyloxy)propanoates yields acrylate esters and propionic acid, and further hydrolysis of the acrylate esters yields acrylic acid. The synthetic method provides quantitative yields of the 2-(propionyloxy)propanoates, making it ideal for scale-up use in industry, and the catalytic species can be generated in situ in both in the neat alkyl lactate and in organic solvent from inexpensive and readily available starting materials.

## **Biorenewable Starting Materials**

Acrylic esters are currently derived directly from acrylic acid produced from byproducts of ethylene and gasoline production. Moving away from petroleum based feedstocks towards a biorenewable starting material is of key interest, and the technology presented here provides a viable route from bio-derived lactate esters to acrylic esters via a catalytic, two-step process. The synthesis can be done under neat conditions, avoiding the need for solvent, and takes place at just 80 degrees Celsius, a significant improvement over other methods that require temperatures higher than 250 Celsius.

#### **BENEFITS AND FEATURES:**

- Bio-renewable lactic acid used as starting material
- Hydroesterification using CO and ethylene in presence of palladium catalyst
- Simple catalytic, two-step process
- Uses inexpensive and readily available feedstocks
- Does not require solvents
- High yield; alkyl 2-propionyloxy propanoate intermediate yields are quantitative Conversion to acrylate and propionic acid via simple pryrolysis
- Relatively inexpensive reactants and low energy costs

#### APPLICATIONS:

- Bio-derived synthesis of acrylic acid and acrylate esters
- Bio-derived polyacrylic acid and polyacrylate polymers
- Bio-derived propionic acid for animal feed and food preservative

Phase of Development - Proof of Concept

## Researchers

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## **Technology ID**

20180106

## Category

Engineering & Physical
Sciences/Materials
Engineering & Physical
Sciences/Sustainable Technology
Life Sciences/Industrial Biotech
Agriculture & Veterinary/Food
Science & Nutrition

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#### **Publications**

<u>Bioderived Acrylates from Alkyl Lactates via Pd-Catalyzed Hydroesterification</u>
ACS Sustainable Chemistry and Engineering, July 19, 2018

#### **External Links**

Center for Sustainable Polymers

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