



# 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 pyrolysis
- 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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[External Link](#) (chem.umn.edu)

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#### **Publications**

[\*Bioderived Acrylates from Alkyl Lactates via Pd-Catalyzed Hydroesterification\*](#)

*ACS Sustainable Chemistry and Engineering*, July 19, 2018

#### **External Links**

[Center for Sustainable Polymers](#)

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