# Biobased Curing Agent for Epoxy

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## Introduction

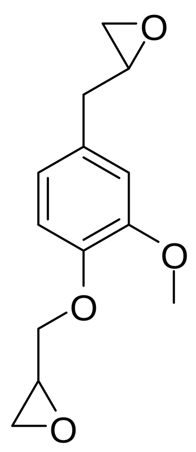
I am assisting Dr. Jianglei Qin on his research on developing biobased epoxy resins for practical application. My part is in preparing the biobased curing agent needed to cure the epoxy resin, eugenol epoxy (scheme 1), for his research. I modified to prepare the biobased curing agent Methyl Maleopimarate (MMP) from Maleopimaric Acid (MPA) (scheme 2), and studied the curing of eugenol epoxy with MPA.

## Basic Information

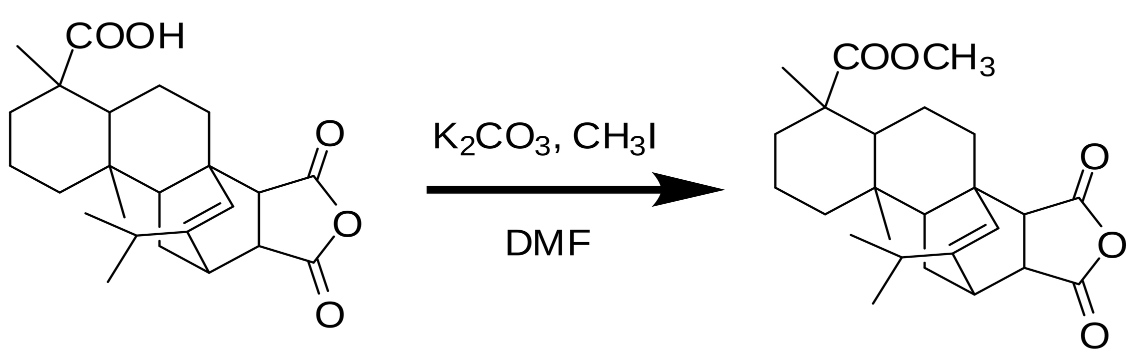
Epoxy Resins are malleable resins widely used for adhesives, laminates, and coatings.

## Process of Preparing Biobased Curing Agent

Approximately 1mmol of maleopimaric acid and 5 mmol of $CH_3I$ were reacted in 50 ml of DMF catalyzed by 3 mmol of $K_2CO_3$ for 15 hours. The DMF was then evaporated and the product dissolved in 100ml of ethyl acetate and washed three times with water. Finally, the product was dried with $MgSO_4$ and the solvent evaporated to obtain the final dry product.



Scheme 1: Structure of Eugenol Epoxy



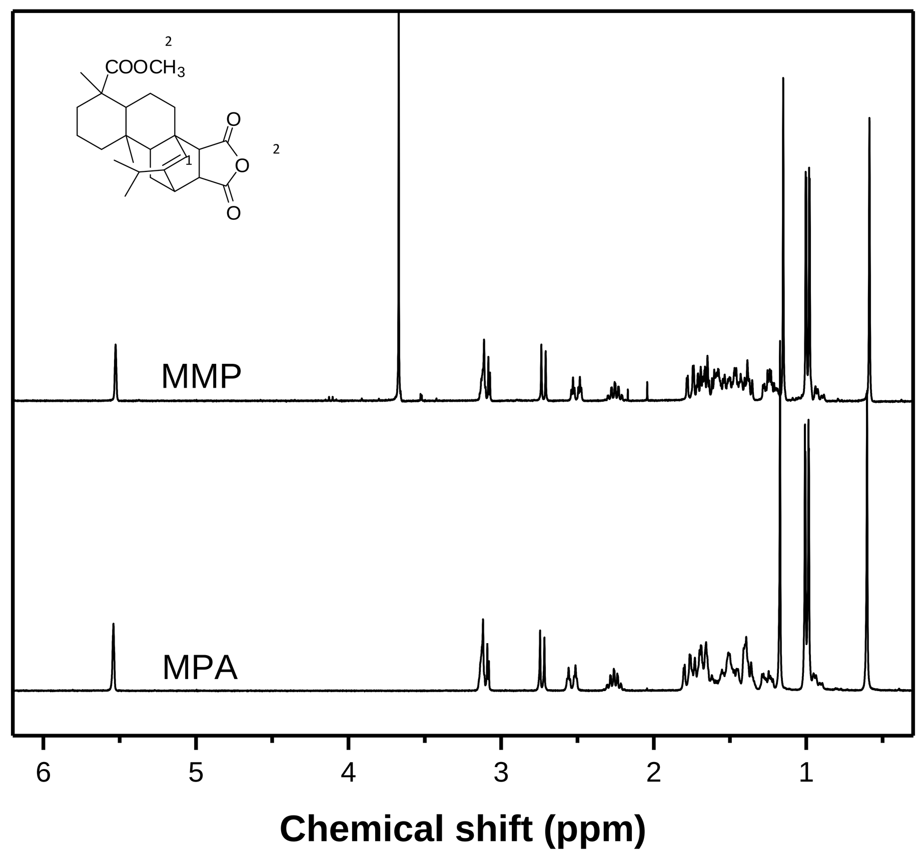

Scheme 2: The synthetic route from MPA to MMP

## Importance

With the higher demand for greener products and the increasing costs for fossil resources, biobased materials from renewable resources are becoming more and more popular as a topic of research. Also with the health hazards associated with petroleum based materials, there is a desire to use more environment and health friendly resources.

So, instead of using petrochemical curing agents, research is being done to look into rosin-based acid anhydrides as an alternative. Rosin is abundantly available and is similar in rigidity to the petroleum-based compounds.

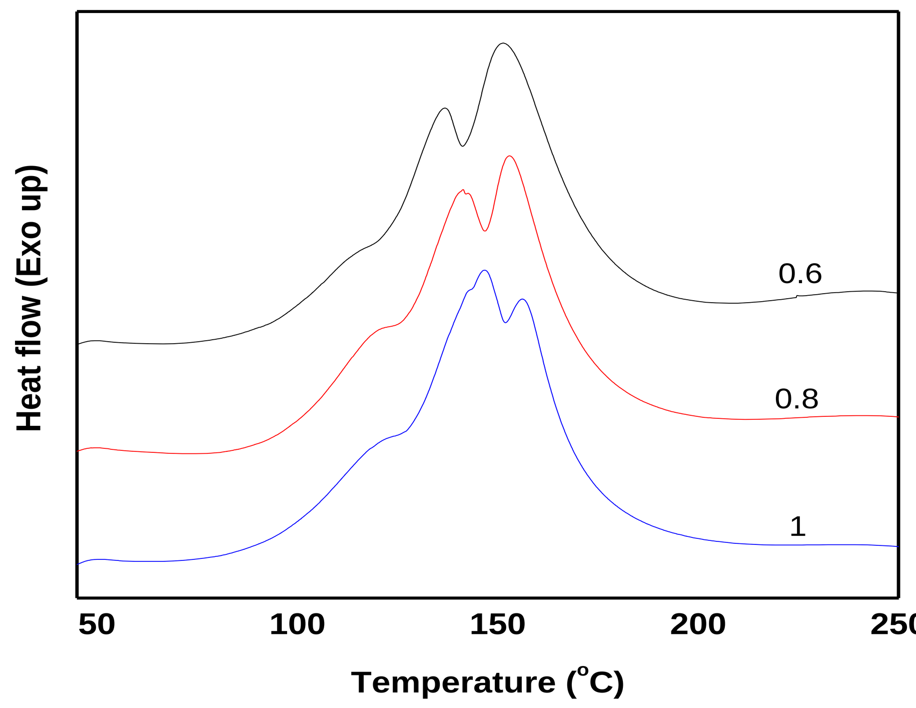
## NMR Spectra of MPA and MMP



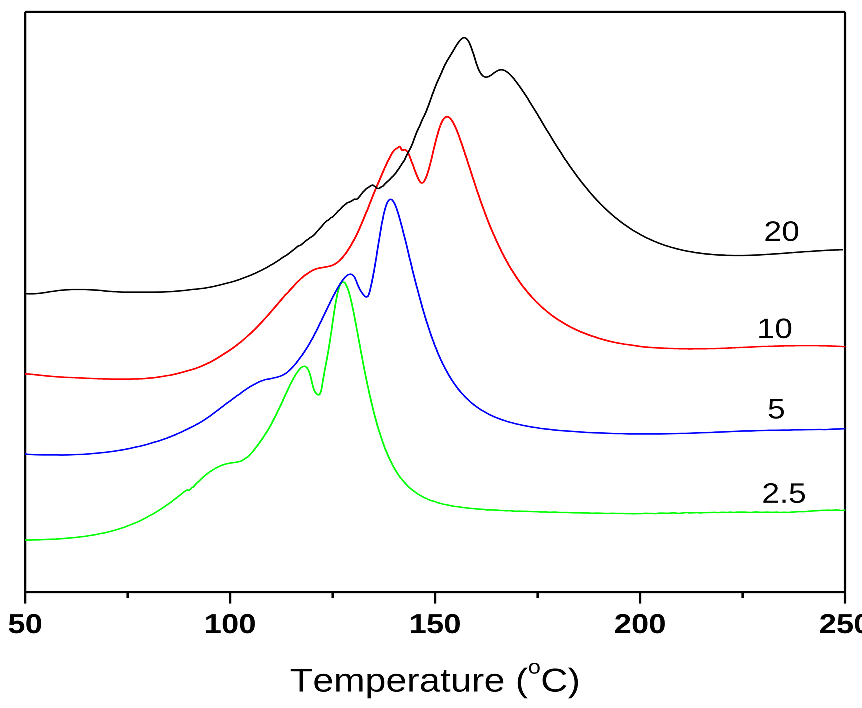

## Discussion

The synthesis of MMP from MPA was quite successful and produced a fairly high yield of product. Previous methods tried include synthesis of MMP from abietic acid with a two step process including synthesis of methyl abietate followed by the synthesis of MMP, producing slightly less yield. This process using MPA was modified from previous experiments and took less steps to complete, used less chemicals, and produced higher overall yield than previous methods. The heat flow of MPA as a curing agent showed multipeaks and multisteps. The curing curve of the eugenol epoxy with rosin acid indicates that the multipeaks are caused by different activities of different groups in the curing agent.

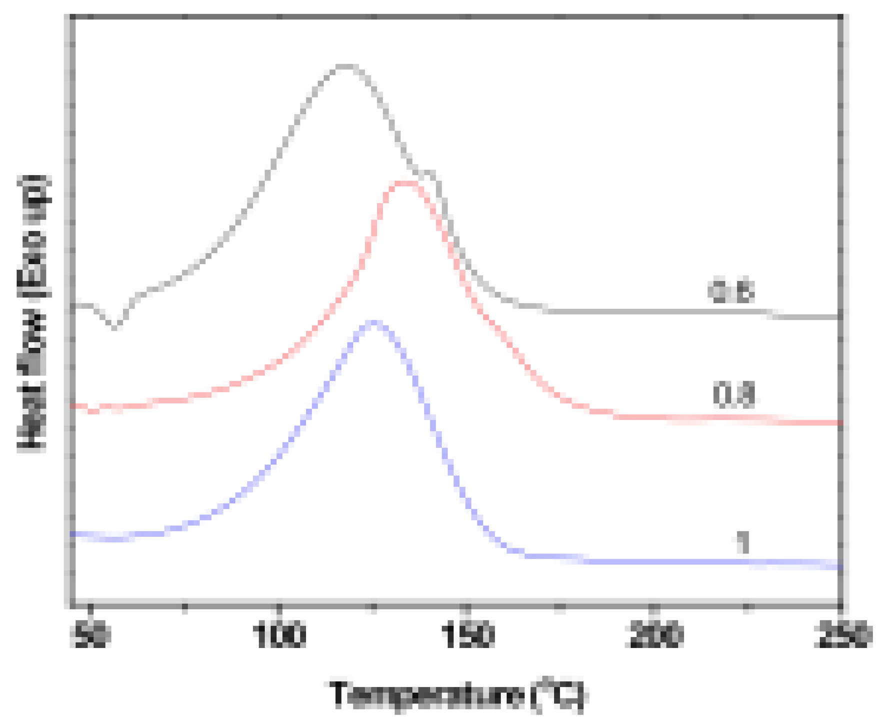
## Results Thus Far




Heat flow of eugenol epoxy cured with various group ratios of maleopimaric acid (10°C/min).




Heat flow of eugenol epoxy cured with the 0.8 group ratio of maleopimaric acid at various heating rates (°C).




Heat Flow of eugenol epoxy with various group ratios of rosin acid.

Acknowledgments:

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Reference Articles:

Liu, X., Xin, W., & Zhang, J. (2009). Rosin-based acid anhydrides as alternatives to petrochemical curing agents. *The Royal Society of Chemistry, 11, 1018-1025. Retrieved from www.rsc.org/greenchem*

Wang, H., Liu, B., Liu, X., Zhang, J., & Xian, M. (2008). Synthesis of biobased epoxy and curing agents using rosin and the study of cure reactions. *The Royal Society of Chemistry, 10, 1190-1196. Retrieved from www.rsc.org/greenchem*

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