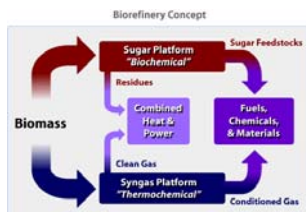


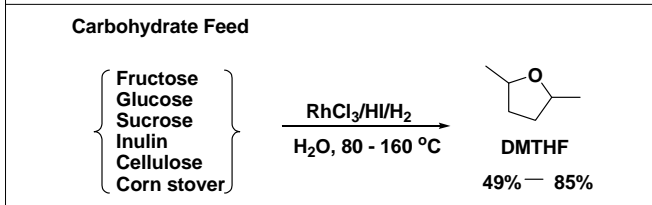
## Introduction

Existing technologies to produce liquid fuel from biomass are typically energy intensive multi-step processes. One exception is the production of ethanol by fermentation of sugars. However, this process has low energy efficiency and uses food stuff as starting materials. Besides, ethanol possesses low energy density, high volatility, and high solubility in water. We propose a single step catalytic method to make 2,5-dimethyltetrahydrofuran (DMTHF) from biomass. DMTHF is superior to ethanol and has all the desirable properties of a transportation fuel.



## Reaction Scheme

**Scheme 1:** One-step transformation of cellulosic biomass to 2,5-dimethyltetrahydrofuran, DMTHF



## Process Merits

- Uses cheapest and most abundantly available sources of biomass, such as cellulose and raw corn stover
- Removes most oxygen atoms but keeps all the carbon content from the biomass
- Employs environmentally benign, high yield, energy efficient conditions
- Makes liquid fuels of low volatility and high energy content

## Initial Results

**Table 1:** Transformation of carbohydrates to liquid fuels<sup>[a]</sup>

Carbohydrate	Fructose	Inulin	Sucrose	Xylose <sup>[c]</sup>	Glucose	Cellulose	Corn stover <sup>[d]</sup>
DMTHF Yield <sup>[b]</sup> (%)	85	77	86	80	80	80	49

[a] Entries 1-4 were performed at 140 °C, entries 5-7 were performed at 160 °C. [b] Isolated yield. [c] When xylose is the starting material, 2-methyltetrahydrofuran (MTHF) was obtained. [d] 56% of MTHF was also obtained at the same time.

## Catalyst Recycling

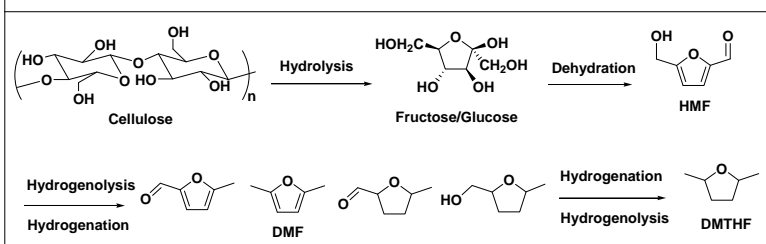
**Table 2:** Recycling of the Catalyst in Fructose Conversion<sup>[a]</sup>

Cycle #	1	2	3	4	5	6	7	8	9	10 <sup>[b]</sup>
DMTHF yield (%)	81	91	85	82	85	79	91	86	83	84

[a] Reactions were performed at 80 °C. Yield of DMTHF was determined by <sup>1</sup>H NMR using nitromethane as internal standard. [b] The aqueous solution was filtered and the filtrate used for cycle 10.

## Reaction Pathway Study

**Scheme 2:** Proposed reaction pathway from cellulose to DMTHF



## Conclusion

We have discovered a simple method to produce pure DMTHF catalytically from biomass in one step. High yields of DMTHF have been obtained from biomass derived carbohydrates, cellulose and even raw corn stover, which are the best results that have even been reported. DMTHF is superior to ethanol and has all the desirable properties currently found in typical petroleum-derived transportation fuels. Thus, DMTHF could be readily incorporated into the existing transportation infrastructure.