Selective Hydrogenolysis of Xylitol using Ruthenium Catalysts

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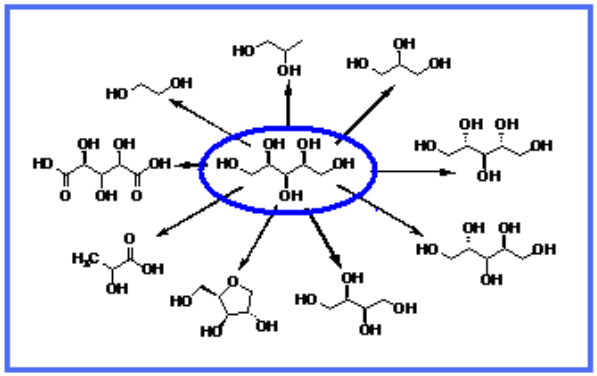
Introduction

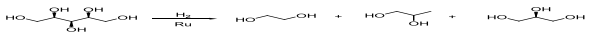
As fossil fuel sources dwindle, we need to find alternative ways of obtaining chemicals previously derived from them. We focused on the conversion of the biomass-derived polyol, xylitol.

Hemi-cellulose → Xylitol

Xylitol has many conversion products:



We investigated selective hydrogenolysis using ruthenium catalysts to three useful chemicals:



Experimental

Reactions of solutions of xylitol (10% by weight) were carried out in an autoclave .

Overall Process:

Catalyst Preparation

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Reaction with Xylitol (Using Autoclave)

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Collection and Pretreatment of Products

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Product Characterization Using HPLC and GC

Results

We examined the effects varying certain reaction parameters had on the efficiency and selectivity of the catalyst:

Metal Center Composition

Cat.	Temp (°C)	Time (min)	Conversion (C %)
Ru/C	240	10	25.7
Pt/C	240	150	12.6
Cu/C	200	360	15.5

Various Ruthenium Supports

Cat. (Ru/)	Temp (°C)	Time (min)	Conver-sion (C %)	Selectivity (% Ethylene Glycol)
C	240	10	25.7	5.5
Al2O3	240	10	18	4.4
ZrO2	240	10	37.8	2
Al-MgO	240	150	28.9	20.7
Zr-MgO	240	30	22.3	24.1

Presence of Base (CaO)

Cat.	Temp (°C)	Conversion (C %)	Selectivity (% EG)
Ru/C	200	31.7	28.9
Pt/C	240	21	12
Ru-Cu1/C	240	35.8	29.9
Ru-Pt1/C	240	32	22.4
Ru-Pd1/C	240	24.1	21.2

Conclusions

- Ruthenium is a more active catalyst than are either platinum or copper
- Al-MgO and Zr-MgO ruthenium supports are the most selective
- The presence of a base increases selectivity of target molecules

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