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Catalytic Conversion of Biorenewable Sugar Feedstocks into Market Chemicals

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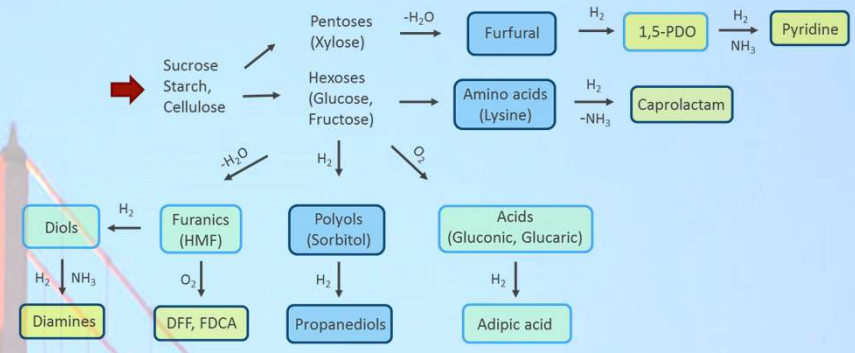
Alvacat

Company Profile

- Contract research
- Heterogeneous catalysis, Materials science
- Renewables
- Environmental catalysis
- Hydrogen storage catalysis
- Energy storage, Battery materials
- Custom catalyst and support development
- Lab scale, bench scale and scale up
- Catalyst carrier and solution inventory
- High throughput synthesis and screening
- Partnered with tollers for scaleup, piloting, manufacturing and metal recycling

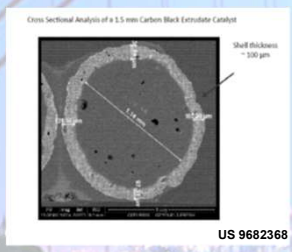
Conversion of Renewable Sugar Feedstocks into Market Chemicals

Carbohydrates Transformations



Glucose Oxidation

Bimetallic PGM shell catalyst



US 9682368

Product analyses after 1200h TOS

flow rate	glucose	gluconic	glucaric	guluronic	on path
kg/h	feed	acid	acid	acid	percentage
1.3	0.4	43.6	37.8	7.4	90
0.65	0	20.7	58.3	4.4	84

US 9776945

HMF Reduction

HMF conversion

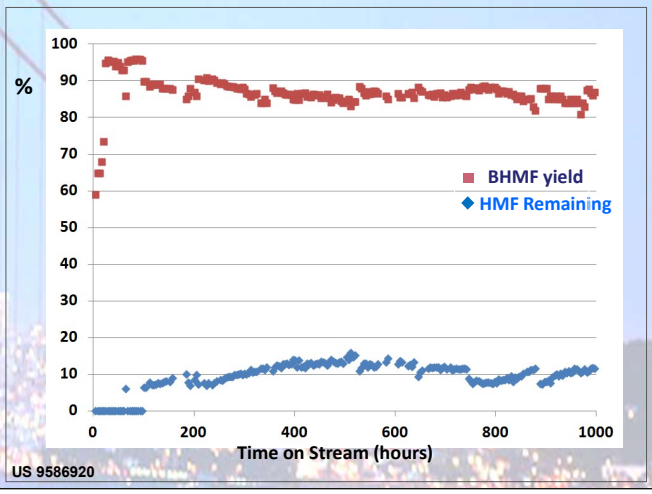
to BHMH

in isopropanol

Fixed bed reactor

Pt-Au-Al_2O_3 catalyst

110°C, 1000 psi H_2



US 9586920

Novel Ni – carbon composite material

Ni catalysts hydrogenation activity test

Example	Catalyst	BHMTHF yield, %	1,2,6-HTO yield, %	Mass balance, %	BHMTHF selectivity, %
1	10% Ni/C	84	0	84	84
2	15% Ni/C	97	0	97	97
3	20% Ni/C	92	0	92	92
4 (comparative)	15.3% Ni/Al2O3	91	7	99	92

US 2017/0120223

Ni/C is stable at high temperatures under aqueous conditions

References
1. Diamond, G., Hagemeyer, A., Murphy, V., Sokolovskii, V., *Combinatorial Chemistry & High Throughput Screening* 21, 616-630 (2018).
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3. US 9776945, Preparation and separation of di-carboxylic acid-containing mixture. Assigned to Rennovia, Oct. 3, 2017.
4. US 9808790. Process for manufacturing of oxidation catalysts. Assigned to Rennovia, Nov. 7, 2017.
5. US 9993802, Shaped porous carbon product. Assigned to ADM, Jun. 12, 2018
6. US 9586920, Process for production of hexanetriol from 5-hydroximethylfurfural. Assigned to Rennovia, Mar. 7, 2017.
7. US2017/0120223, Porous shaped metal-carbon products. Assigned to Rennovia, May 4, 2017.

Conclusions

Glucose to Glucaric to Adipic Acid
- 2-step process for adipic acid developed
- successfully demonstrated at pilot scale
- stable operation for 1200h TOS
- 95-90% on-path selectivities

- HMF to BHMF to HTO
- steady state BHMF yield of 90% over 1000h TOS

- Challenges for liquid phase catalysis
- long-term catalyst stability
- hydrothermally stable supports and catalyst formulations
- shell catalysts to overcome diffusion limitations
- prevent irreversible catalyst deactivation
  - metal leaching