Supplementary Material
Catalytic Conversion of High Fructose Corn Syrup to Methyl Lactate with CoO@silicalite-1

Yuxi Jiang [1], Xilei Lyu [1,2,*], Hao Chen [1], Xiwen Wei [1], Zihao Zhang [3], and Xiuyang Lu [1,*]

[1] Key Laboratory of Biomass Chemical Engineering of Ministry of Education, College of Chemical and Biological Engineering, Zhejiang University, Hangzhou 310027, China; 11928049@zju.edu.cn (Y.J.); chenhaoch@hnu.edu.cn (H.C.); weixiwen1998@163.com (X.W.)
[2] Institute of Chemical Engineering, Zhejiang Hengyi Petrochemical Research Institute Co., Ltd., Hangzhou 311209, China
[3] Paul Scherrer Institute, Villigen 5232, Switzerland; utzhangzihao@gmail.com
* Correspondence: 11428044@zju.edu.cn (Xilei Lyu); luxiuyang@zju.edu.cn (Xiuyang Lu)

Materials and Chemicals

Polyvinylpyrrolidone and $Co(NO_3)_2 \cdot 6H_2O$ (99%) were purchased from Aladdin Chemicals (Shanghai, China). Silica gel (30 wt% in water) and citric acid monohydrate (99.5%) were bought from Macklin regent (Shanghai, China). Methyl lactate (98%), tetrapropylammonium hydroxide (25 wt% in water), and methanol (AR) were bought from the Sinopharm Chemical Reagent (China). Methoxyacetaldehyde dimethyl acetal (98%) was purchased from J & K Scientific (Beijing, China). Glycolaldehyde dimethyl acetal (98%) and HFCS-55 were supplied by Alfa Aesar and Qianfengxiang Food Co., Ltd (Wuhan, Hubei), respectively.

Detailed preparation of catalyst

The synthesis of c-CoO@silicalite-1 via a steam-assisted method followed the procedure of our group [1] with some modifications. Briefly, a certain amount of $Co(NO_3)_2 \cdot 6H_2O$ and 0.1 g PVP were dissolved in 30 mL water and stirred until the solution become transparent. Then, under stirring 3 g silica gel (30 wt% in water) was added and the mixture was stirred for 10 min. Then 1.5 g tetrapropylammonium hydroxide (TPAOH, 25% in water) was added into the mixture. After they were stirred at room temperature for 15 min the solution was rotary evaporated at 50 °C. After removing all the water, the dry gel was placed in the 50 mL Teflon cup and that was placed into a 100 mL Teflon-lined autoclave. A certain amount of water was added outside the Teflon cup (the mass ratio of water to dry gel is 1:5). Afterwards, the autoclave was heated to 130 °C for 3 days. The obtained solid was washed for three times with ethanol, water, and ethanol, respectively. And then the solid was dried under 60 °C for 12 h followed by calcination at 550 °C for 6 h to remove residual template. Before catalytic reaction the zeolite was only pretreated with citric acid (0.5 M, 70 °C, 100 mL/g zeolite, 2 h), then washed with water and dried for 12 h. Finally, the solid sample was calcined at 550 °C for 6 h to obtain c-CoO@silicalite-1. A series of synthesized catalysts was identified as c-Co_x, where x is the amount of $Co(NO_3)_2 \cdot 6H_2O$ (mmol) required in the synthesis of the catalyst. The pictures of the Teflon-lined autoclave and the Teflon cup were shown in Figure S1.

Figure S1

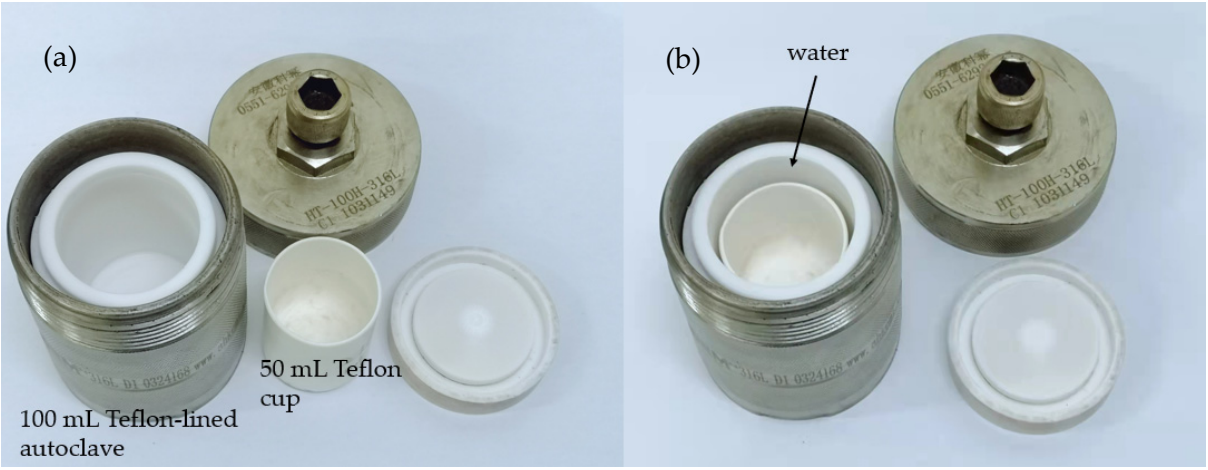

Figure S1. The Teflon-lined autoclave (a) and the Teflon cup (b).

Figure S2

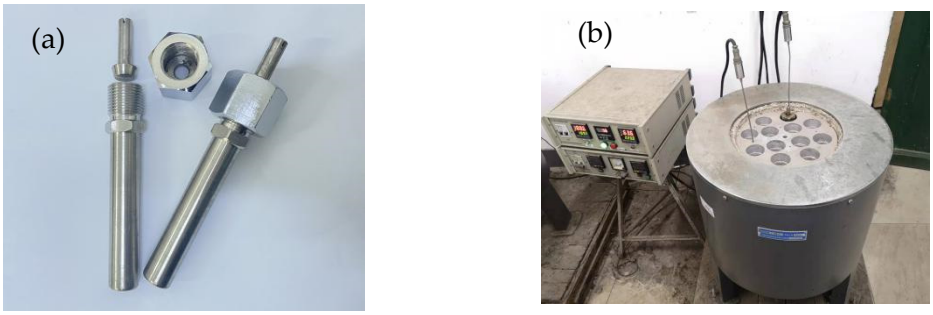

Figure S2. The photos of the stainless steel reactor (a) and heating furnace (b).

Table S1

Table S1. Composition of HFCS-55 detected by HPLC

	Content	Relative content of fructose and glucose
fructose	41.1%	55.9%
glucose	32.4%	44.1%

Figure S3

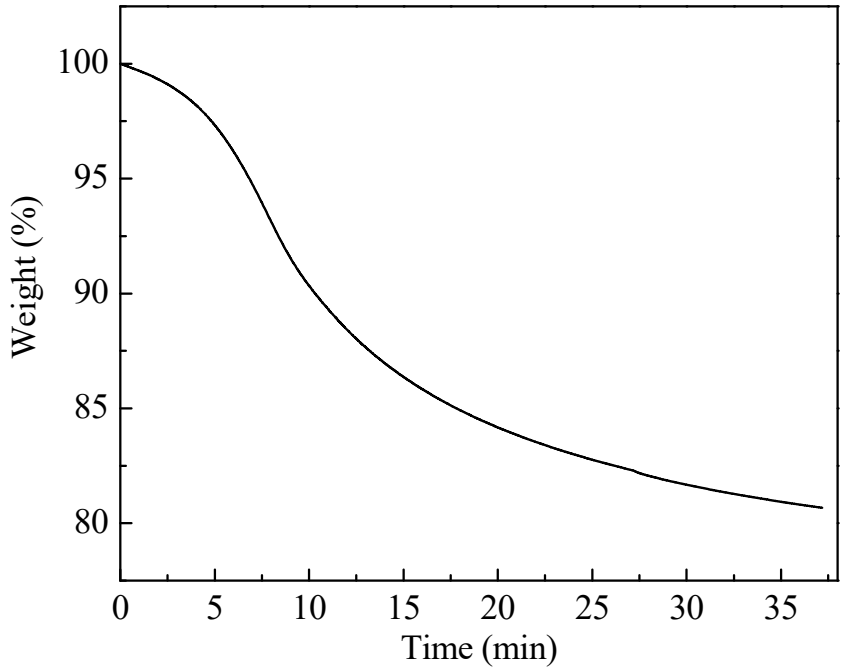

Figure S3. TG analysis of HFCS-55.

Figure S4

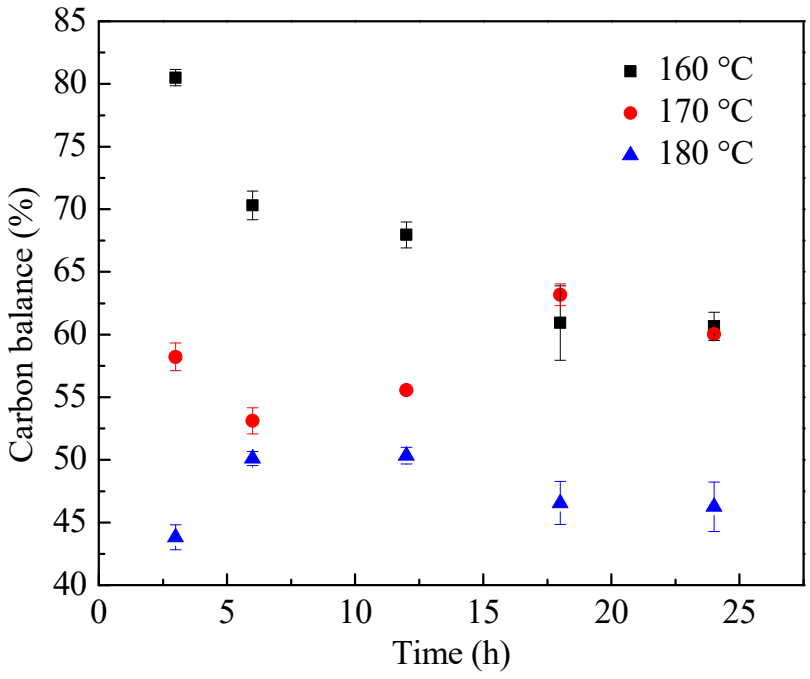

Figure S4. The carbon balance of the catalytic conversion of HFCS-55 under different reaction temperatures and time.

References

1. Yan, Y.; Zhang, Z.; Bak, S.-M.; Yao, S.; Hu, X.; Shadike, Z.; Do-Thanh, C.-L.; Zhang, F.; Chen, H.; Lyu, X.; et al. Confinement of Ultrasmall Cobalt Oxide Clusters within Silicalite-1 Crystals for Efficient Conversion of Fructose into Methyl Lactate. *ACS Catal.* **2018,** 9, 1923–1930. https://doi.org/10.1021/acscatal.8b03230