Supporting Information

Application of BPH zeolite for the transesterification of glycerol to glycerol carbonate: effect of morphology, cation type and reaction condition

Siriporn Kosawatthanakun,[a] *Edwin B. Clatworthy,*[*b] *Sajjad Ghojavand,*[b] *Narongrit Sosa,*[ac] *Jatuporn Wittayakun,*[*a] *and Svetlana Mintova,*[b]

[a] School of Chemistry, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand

[b] Normandie Université, ENSICAEN, UNICAEN, CNRS, Laboratoire Catalyse et Spectrochimie (LCS), 14050 Caen, France

[c] Nuclear Technology Research and Development Center, Thailand Institute of Nuclear Technology (Public Organization), Nakhon Nayok 26120, Thailand

Corresponding Authors

*E-mail: jatuporn@sut.ac.th

*E-mail: edwin.clatworthy@ensicaen.fr

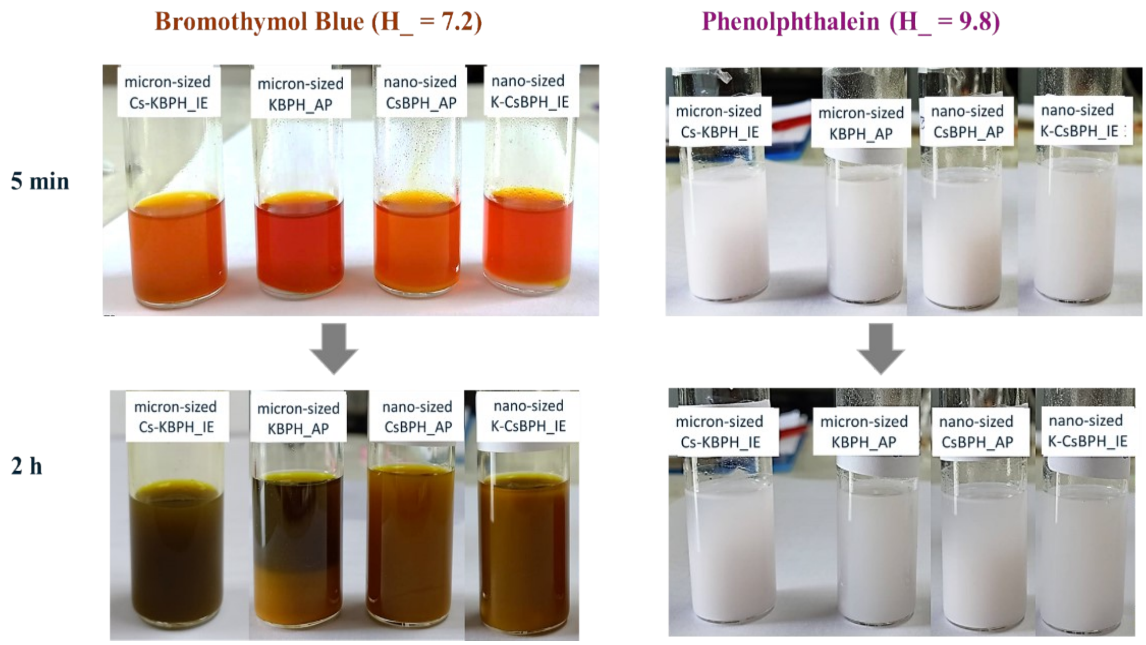

Fig. S1. Basicity strength (H_) of catalysts using the Hammett indicator.

Table S1. BET surface area and external surface of nano-sized and micron-sized BPH zeolites from N_2 adsorption-desorption analysis.

Sample name	BET surface area ($m^2 \cdot g^{-1}$)	External surface area ($m^2 \cdot g^{-1}$)
micron-sized KBPH_AP	29	19
micron-sized Cs-KBPH_IE	25	16
nano-sized CsBPH_AP	196	80
nano-sized K-CsBPH_IE*	388	69
reused nano-sized CsBPH_AP_4th	208	87

Degas condition at 300 ºC, 8 h, rate 10 °C·min^{-1} and micron-sized BPH zeolite were degassed at 120 ºC, 24 h using Micromeritics 3Flex physisorption instrument, measurements performed at -196 °C.

*Degas condition: 350 °C, 8 h, rate 5 °C·min^{-1} using a Micromeritics ASAP 2020 volumetric adsorption analyzer, measurements performed at -196 °C.

Table S2. Comparison of best catalysts in this work with best catalysts from literature

Catalyst	Reaction condition				Reaction activity (%)			Refs.
	solvent	Temp. (ºC)	Time (h)	Gly:DMC molar ratio	Gly conversion	GC yield	GC selectivity	
Li/OPAZ (zeolite beta)	-	70	1.5	1:2	99	98	-	1
$Li/Mg_4AlO_{5.5}$	-	80	1.5	1:3	100	96	96	2
LDH/SBA-15	DMF	100	2	1:3	78	70	90	3
K/TUD-1	-	90	2.5	1:5	98	92	97	4
K-CHA	-	75	1.5	1:3	100	96	-	5
NaY	Methanol	70	4	1:3	80	-	100	6
NaBEA	Methanol	70	4	1:3	37	-	100	6
Nano-sized CsBPH_AP	-	120	3	1:5	83	80	96	This work

REFERENCES

1. W. A. Khanday, P. U. Okoye and B. H. Hameed, Biodiesel byproduct glycerol upgrading to glycerol carbonate over lithium–oil palm ash zeolite, *Energy Convers. Manag.*, 2017, **151**, 472-480.

2. Z. Liu, J. Wang, M. Kang, N. Yin, X. Wang, Y. Tan and Y. Zhu, Structure-activity correlations of $LiNO_3/Mg_4\ AlO_{5.5}$ catalysts for glycerol carbonate synthesis from glycerol and dimethyl carbonate, *J. Ind. Eng. Chem.*, 2015, **21**, 394-399.

3. Q. M. She, W. J. Huang, A. Talebian-Kiakalaieh, H. Yang and C. H. Zhou, Layered double hydroxide uniformly coated on mesoporous silica with tunable morphorlogies for catalytic transesterification of glycerol with dimethyl carbonate, *Appl. Clay Sci.*, 2021, **210**.

4. S. Arora, V. Gosu and V. Subbaramaiah, One-pot synthesis of glycerol carbonate from glycerol using three-dimensional mesoporous silicates of K/TUD-1 under environmentally benign conditions, *Mol. Catal.*, 2020, **496**.
5. Y. T. Algoufi and B. H. Hameed, Synthesis of glycerol carbonate by transesterification of glycerol with dimethyl carbonate over K-zeolite derived from coal fly ash, *Fuel Process. Technol.*, 2014, **126**, 5-11.
6. S. Pan, L. Zheng, R. Nie, S. Xia, P. Chen and Z. Hou, Transesterification of glycerol with dimethyl carbonate to glycerol carbonate over Na–based zeolites, *Chinese J. Catal.*, 2012, **33**, 1772-1777.