

## Supplementary Information

### Highly selective conversion of diols into aldehydes for the purification of ethylene glycol with a self-adjusting coupling reactor

Jianwei Ji <sup>a</sup>, Shuo Ai <sup>\*,b</sup>, Wanguo Yu <sup>b</sup>, Linghui Liu <sup>b</sup>, Chengdu Huang <sup>b</sup>

<sup>a</sup> School of Chemical & Environmental Science, Shaanxi University of Technology, Hanzhong 723001, China

<sup>b</sup> College of Biological and Chemical Engineering, Guangxi University of Science and Technology, Liuzhou 545006, China

Corresponding authors: Shuo Ai, Email address: 100001928@gxust.edu.cn

**Table S1.** Effect of reaction temperature on the coupled reactions.

**Table S2.** Effect of propanal dosage on the coupled reactions.

**Table S3.** Effect of water dosage on the coupled reactions.

**Table S4.** Product selectivity data in the stability test of catalyst.

**Table S1** Effect of reaction temperature on the coupled reactions<sup>a</sup>

Temperature/ K	Conv. <sub>p</sub> DO (%)	Conv. BDO (%)	PDO-based selectivity (%)					BDO-based selectivity (%)				DEG and TEG yield (%)	EG recovery (%)
			propanal	acetone	EMD	ED	oligomer	butadiene	butanal	butanone	PD		
433	58.5	63.7	11	1.1	14.6	44.5	28.8	1.4	77.8	7.2	13.7	2.8	82.2
453	81.6	82.8	70.5	1.3	2	8.7	17.4	2.6	89.8	6.7	0.9	6.1	84.6

<sup>a</sup> Feedstock: 21.9 g of EG, 6 g of PDO, 2.1 g of BDO; 4-h reaction; dehydration conditions at 433 K: 2.6 g of H-Beta, 300 rpm; dehydration conditions at 453 K: 1.4 g of H-Beta, 300 rpm; Hydrolysis conditions: 0.2 g of Amberlyst-15, 350 K, 15 mL/min N<sub>2</sub>.

**Table S2** Effect of propanal dosage on the coupled reactions<sup>a</sup>

Propanal added (g)	Conv. <sub>P</sub> D <sub>0</sub> (%)	Conv. <sub>B</sub> D <sub>0</sub> (%)	PDO-based selectivity (%)					BDO-based selectivity (%)				DEG and TEG yield (%)	EG recov ery (%)
			propanal	acetone	EMD	ED	oligomer	butadiene	butanal	butanone	PD		
0	79.6	81.2	75.6	1.5	1.9	11.7	9.3	3.3	84.6	10.7	1.4	5.1	85.6
0.5	82	84.3	72.1	1	6.3	12.6	8	2.8	80.1	13.5	3.6	5.5	83.4

<sup>a</sup> Dehydration conditions: 21.9 g of EG, 6 g of PDO, 2.1 g of BDO, 1.4 g of H-Beta, 300 rpm, 4 h; Hydrolysis conditions: 0.2 g of Amberlyst-15, 350 K, 15 mL/min N<sub>2</sub>.

**Table S3** Effect of water dosage on the coupled reactions<sup>a</sup>

Water added (g)	Conv. <sub>P</sub> D <sub>O</sub> (%)	Conv. <sub>B</sub> D <sub>O</sub> (%)	PDO-based selectivity (%)					BDO-based selectivity (%)				DEG and TEG yield (%)	EG recovery (%)
			propanal	acetone	EMD	ED	oligomer	butadiene	butanal	butanone	PD		
0	79.6	81.2	75.6	1.5	1.9	11.7	9.3	3.3	84.6	10.7	1.4	5.1	85.6
2	82.2	85.7	76.6	0.9	3.8	10.2	8.5	2.1	82.8	12.1	3	5.9	81.7

<sup>a</sup> Dehydration conditions: 21.9 g of EG, 6 g of PDO, 2.1 g of BDO, 1.4 g of H-Beta, 300 rpm, 4 h; Hydrolysis

conditions: 0.2 g of Amberlyst-15, 350 K, 15 mL/min N<sub>2</sub>.

**Table S4** Product selectivity data in the stability test of catalyst<sup>a</sup>

Run	Conv.	Conv.	PDO-based selectivity (%)					BDO-based selectivity (%)				DEG and	EG
	PDO (%)	BDO (%)	propanal	acetone	EMD	ED	oligomer	butadiene	butanal	butanone	PD	TEG yield (%)	recovery (%)
1	95.8	96.3	85.7	1.3	1.7	7.3	4	1.4	86.6	10.4	1.6	13.3	74.5
2	95.7	96.3	86.6	1	1.5	7.4	3.4	1.9	87.3	10.1	0.8	14.1	74
3	92.5	94.5	86.3	1.2	2.2	6.7	3.6	2.1	82.4	12.3	3.1	13.4	71.4
4	96	96.4	84.4	1.3	1.9	8.4	4	1.4	86.7	11	0.9	14	71.4
5	95.1	95.4	86.4	1.3	1.6	7.4	3.3	1.6	86.9	10.6	0.9	13.6	72.8

<sup>a</sup> Dehydration conditions: 21.9 g of EG, 6 g of PDO, 2.1 g of BDO, 1.8 g of H-Beta, 453 K, 300 rpm, 6 h; Hydrolysis conditions: 350 K, 0.3 g of Amberlyst-15, 15 mL/min N<sub>2</sub> in the last 2 h.