



Supplementary material: Highly efficient conversion of glycerol and *t*-butanol to biofuel additives over AlPO solid acid catalyst under microwave irradiation technique: kinetic study

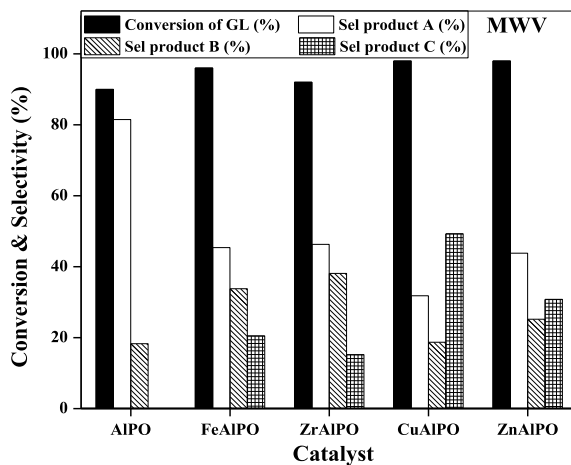
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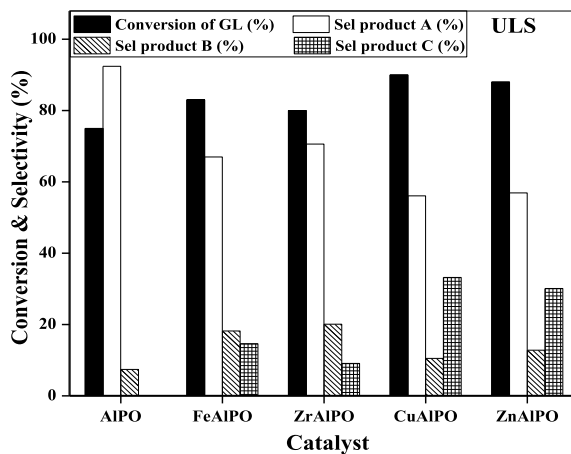
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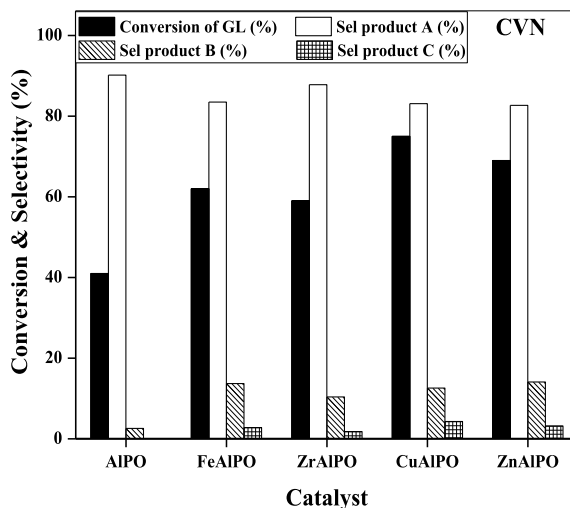
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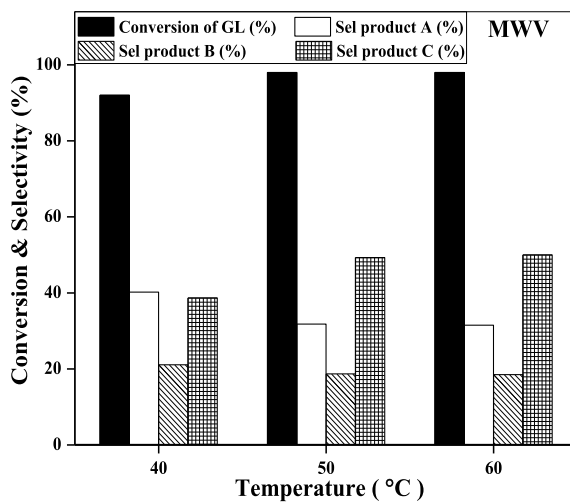
Supplementary Figure S1. Etherification reaction between GL and TBuA over AlPO, FeAlPO, ZrAlPO, CuAlPO and ZnAlPO solid acid catalyst under MWV heating. (Reaction condition: molar ratio = 1:4 (GL:TBuA), catalyst weight = 0.08 g, reaction time = 15 min, reaction temperature = 50 °C.)



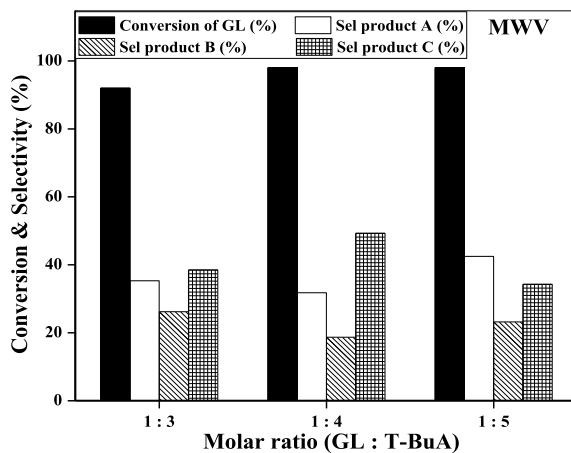
Supplementary Figure S2. Etherification reaction between GL and TBuA over AlPO, FeAlPO, ZrAlPO, CuAlPO and ZnAlPO solid acid catalysts under ULS heating. (Reaction condition: molar ratio = 1:4 (GL:TBuA), catalyst weight = 0.08 g, reaction time = 15 min, reaction temperature = 50 °C.)



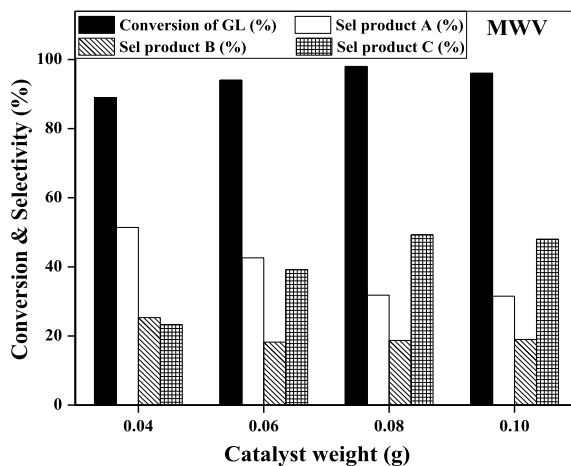
Supplementary Figure S3. Etherification reaction between GL and TBuA over AlPO, FeAlPO, ZrAlPO, CuAlPO and ZnAlPO solid acid catalysts under CVN heating. (Reaction condition: molar ratio = 1:4 (GL:TBuA), catalyst weight = 0.08 g, reaction time = 15 min, reaction temperature = 50 °C.)



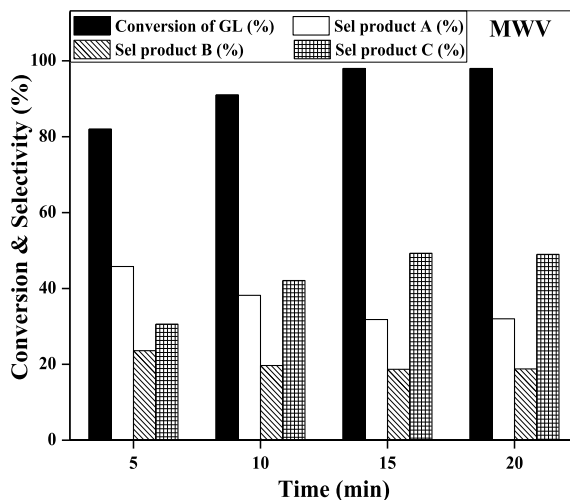
Supplementary Figure S4. Effect of temperature on GL etherification with TBuA over CuAlPO solid acid catalyst under MWV heating. (Reaction condition: molar ratio = 1:4 (GL:TBuA), catalyst weight = 0.08 g, reaction time = 15 min, reaction temperature = 40 to 60 °C.)



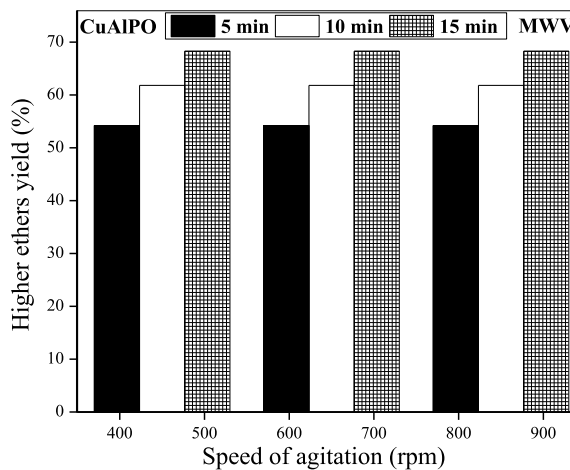
Supplementary Figure S5. Effect of molar ratio on GL etherification with TBuA over CuAlPO solid acid catalyst under MWV heating. (Reaction condition: molar ratio = 1:3 to 1:5 (GL:TBuA), catalyst weight = 0.08 g, reaction time = 15 min, reaction temperature = 50 °C.)



Supplementary Figure S6. Effect of catalyst weight on GL etherification with TBuA over CuAlPO solid acid catalyst under MWV heating. (Reaction condition: molar ratio = 1:4 (GL:TBuA), catalyst weight = 0.04 to 0.10 gm, reaction time = 15 min, reaction temperature = 50 °C.)



Supplementary Figure S7. Effect of time on GL etherification with TBuA over CuAlPO solid acid catalyst under MWV heating. (Reaction condition: molar ratio = 1:4 (GL:TBuA), catalyst weight = 0.08 g, reaction time = 5 to 20 min, reaction temperature = 50 °C.)



Supplementary Figure S8. Effect of the speed of agitation on the yield of higher ethers (%) over CuAlPO under MWV heating method. (Reaction conditions: reaction temperature = 50 °C, reaction time = 5, 10 and 15 min, catalyst weight = 0.08 g, molar ratio = 1:4 (GL:TBuA).)