Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Supporting information

Beta zeolite: a universally applicable catalyst for the conversion of various types of saccharides into furfurals

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1. Figures and Tables

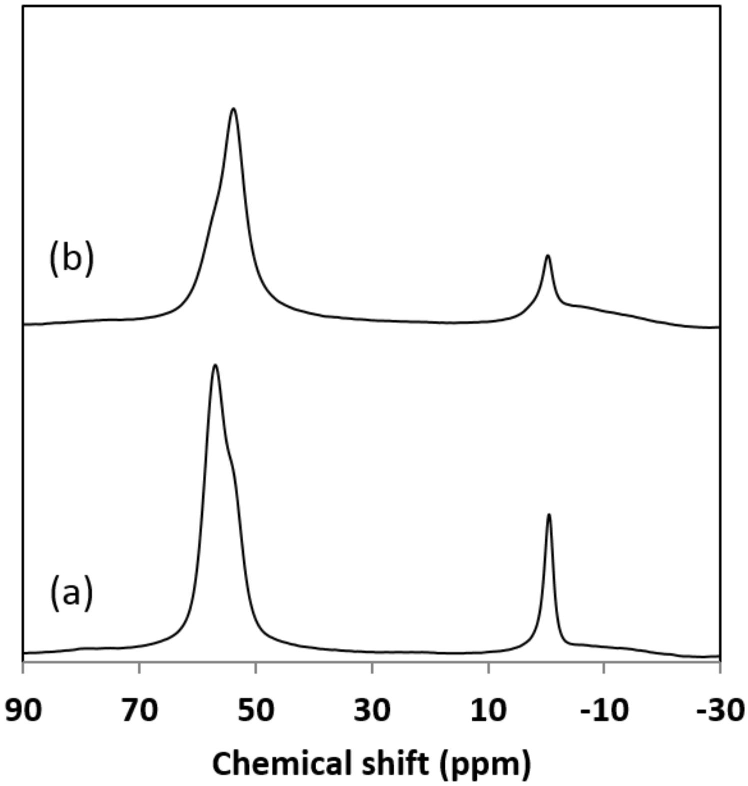

Fig. S1 ^{27}Al MAS NMR spectra (a) Beta-Cal500 and (b) Beta-Cal750.

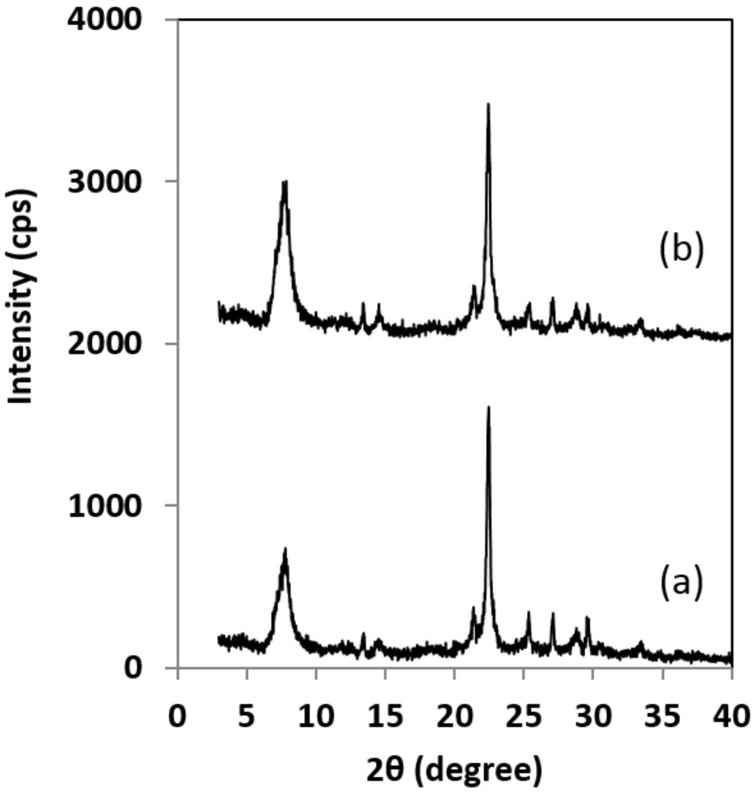

Fig. S2 XRD patterns of (a) Beta-Cal500 and (b) Beta-Cal750.

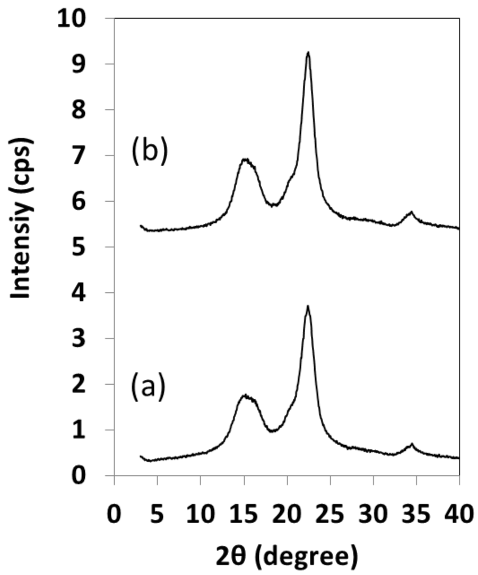

Fig. S3 XRD patterns of the cellulose (a) Before the reaction and (b) recovered after the reaction without a catalyst.

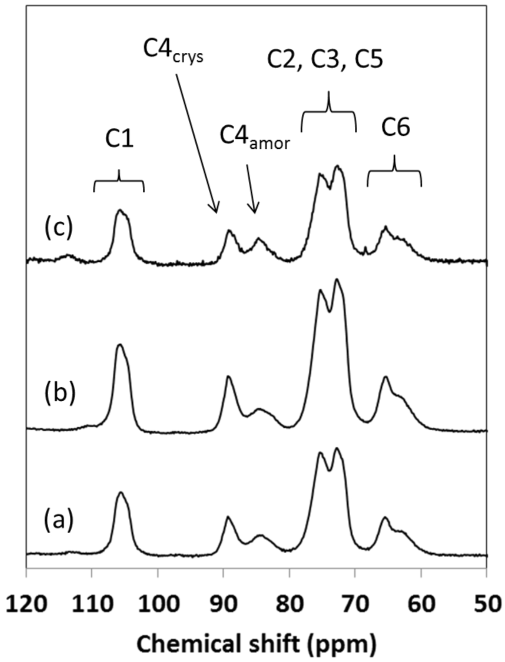

Fig. S4 ^{13}C CP/MAS NMR spectra of the cellulose (a) before the reaction, (b) recovered after the reaction without a catalyst and (c) recovered after the reaction with Beta-Cal750.

Fig. S4 shows ^{13}C CP/MAS NMR spectra of the cellulose before and after the reactions. C4 atoms in crystalline domain and in amorphous domain provided the different chemical shifts at 89 and 84 ppm, respectively (assignments of other peaks are inset). The integrated areas of these signals indicated that the crystallinity of the cellulose before and after the reaction was not changed,[1] even though organic solvents (THF and DMSO) were contained in the reaction mixture. This observation was consistent with the result on XRD analysis (Fig. S3), which is another method for examining the crystallinity of glucan.[2] Scanning electron microscopy provided the information on changes in the morphology of the cellulose during the reaction. Cellulose substrate consisted of particles ~50 μm in size (Fig. 3a in the main text). In the micrograph for the recovered cellulose, large particles larger than 50 μm in size was decreased but smaller particles were found (Fig. 3b). It has been reported that particle size and surface area are critical factors determining the reactivity of cellulose.[3] It has not been understood how the particle size was changed during the reaction, the small particle size could improve the reactivity of crystalline cellulose.

2. References

[1] R.H. Newman, *Holzforschung*, 2004, **58**, 91–96.

[2] a) L. Segal, J.J. Creely, A.E. Martin Jr., C.M. Conrad, *Tex. Res. J.*, 1962, **29**, 786–794; b) Y. Cao, H. Tan, *Enzyme Microb. Tech.*, 2005, **36**, 314–317.

[3] D. Caulfield, W. E. Moore, *Wood Sci.*, 1974, **6**, 375– 379.