

論文 / 著書情報  
Article / Book Information

題目(和文)	糖類を有用化学品へ変換するゼオライト触媒の開発に関する研究
Title(English)	Study on development of zeolite catalysts for conversion of sugars into useful chemicals
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出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第9498号, 授与年月日:2014年3月26日, 学位の種別:課程博士, 審査員:野村 淳子,富田 育義,原 亨和,馬場 俊秀,松下 伸広
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学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

(博士課程)  
Doctoral Program

## 論文要旨

THESIS SUMMARY

専攻 : Department of	物質電子化学	専攻	申請学位 (専攻分野) : Academic Degree Requested	博士 (工学)	Doctor of (Engineering)
学生氏名 : Student's Name	大友亮一		指導教員 (主) : Academic Advisor(main)	野村淳子	
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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

This study focuses on the development of zeolite catalysts in particular routes for conversion of biomass into useful chemicals.

The first chapter summarizes the background for the research involved in this thesis such as general information on chemical conversion of biomass and hydrothermal synthesis of zeolites.

Chapter 2 describes transformation of glucose to 5-hydroxymethylfurfural (HMF) over dealuminated Beta zeolites. Lewis acid sites on the zeolite were remarkably increased when \*BEA-type aluminosilicate was simply calcined over 700 °C or treated with steam over 500 °C. Thus treated Beta zeolites had sufficient amount of Lewis acid sites in addition to the original Brønsted acid sites. Those zeolites with acid properties controlled were effective bifunctional catalysts for the direct transformation of glucose to HMF; Glucose is isomerized to fructose over Lewis acid sites and then fructose is dehydrated to HMF over Brønsted acid sites (55 % selectivity at 78 % glucose conversion).

Chapter 3 describes direct transformation of various types of sugars including hexoses, oligosaccharides and polysaccharides by using the dealuminated Beta zeolite. Beta-Cal750, which has a relatively large amount of Lewis acid sites formed by the dealumination, can effectively promote the transformation of various types of saccharides. Moreover, the reaction system can be applied to the direct conversion of crystalline cellulose to HMF. On the other hand, Beta-Cal500, which has a small amount of Lewis acid sites, shows a better performance in the transformation of xylose than Beta-Cal-750. These results suggest that the suitable acid properties depend on the reactivity of the substrate.

In chapter 4, the transformation of glucose to HMF was investigated by using organic structure-directing agent (OSDA)-free Beta zeolite as catalyst. OSDA-free Beta zeolite can be used without Al atoms leached as an excellent catalyst for the transformation of glucose to HMF. A high B/L ratio with sufficient amount of Lewis acid sites and proximity of the two types of acid sites in the Beta catalyst are crucial factors for effectively producing HMF.

In chapter 5, OSDA-free synthesis of Beta zeolite was studied. The OSDA-free synthesis was successfully achieved starting from high aluminum composition based on the crystallization mechanism. A moderate amount of NaOH is necessary for selective formation of \*BEA crystal phase. The crystallization was initiated by the exposure of seed crystal to the liquid phase, and the crystallization rate was increased by a large amount of seed crystal. Under the hydrothermal conditions employed in this work, crystallization proceeds through the deposition of dissolved species in the form of aluminosilicate onto the surface of seed crystal driven by aluminum species in the solution. When increasing the initial Al content of the starting gel, highly crystalline Beta zeolite was obtained in 84 % yield (conventionally, below 30 %).

In chapter 6, dehydration of sorbitol to isosorbide in water was studied using aluminosilicate zeolites as heterogeneous catalysts. Catalytic performance of a zeolite strongly depends on structural and compositional properties. 3-dimensinal large pore zeolites showed high catalytic activities. Probably due to their hydrophobicity, high-silica zeolites showed better catalytic performances. Hydrothermal stability is an important factor determining the performance of a catalyst in hot liquid water and it is different depending on the framework type.

The last chapter summarizes this thesis.

備考 : 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).