

Index

Chapter 1	Introduction.....	1
1.1.	Historical development of solid acid catalysts.....	1
1.2.	Development of zeolite as solid acid catalyst	3
1.3.	Acidity studies of zeolite catalysts	5
1.3.1.	Aluminum zoning.....	6
1.3.2.	Paired/isolated aluminum species	9
1.3.3.	Aluminum positioning at different T-sites.....	16
1.4.	Design of pores/cavities in zeolites	29
1.4.1.	Mesoporous cavities	29
1.4.2.	Molecular size cavities: OSDA-induced zeolite synthesis.....	33
1.4.3.	Atomic-level cavity design : reaction-adapted synthesis	40
1.5.	References	44
Chapter 2	Objectives	58
Chapter 3	Experimental procedures.....	62
3.1.	Synthesis of materials	63
3.1.1.	Conditions for synthesis of zeolitic materials	63
3.1.2.	ZSM-5 samples using alcohols as OSDA.....	63
3.1.3.	Boron-assisted synthesis of ZSM-5 samples.....	64
3.1.4.	Synthesis of Theta-1 samples	64
3.1.5.	Synthesis of OSDAs.....	65
3.1.6.	Synthesis of zeolites other than ZSM-5.....	68
3.2.	Characterization techniques	72
3.2.1.	Powder X-Ray diffraction (PXRD).....	72

3.2.2.	Inductively coupled plasma atomic emission spectroscopy (ICP-AES)	73
3.2.3.	Elemental analysis (EA)	73
3.2.4.	Thermogravimetric analysis (TGA).....	73
3.2.5.	N ₂ adsorption/desorption measurement	74
3.2.6.	Field emission scanning electron microscope (FE-SEM).....	74
3.2.7.	Nuclear magnetic resonance.....	75
3.2.8.	Temperature programed desorption of NH ₃	76
3.2.9.	Infrared-pyridine	76
3.2.10.	Co ²⁺ -exchange experiments.....	77
3.3.	Catalytic reactions	77
3.3.1.	Catalytic cracking of 1-hexene	77
3.3.2.	Methanol to olefins reaction using medium-pore zeolites.....	78
3.3.3.	Liquid phase transalkylation of diethylbenzene with benzene ...	78
3.3.4.	MTO reaction.....	79
3.4.	Reference.....	80
Chapter 4	Control of Aluminum distribution in zeolite.....	82
4.1.	Introduction.....	83
4.2.	Establishment of an indicator for aluminum distributions.....	85
4.2.1.	Materials synthesis	86
4.2.2.	Materials characterization	87
4.2.3.	development of an indicator for Al location	90
4.3.	Boron-assisted synthesis of ZSM-5.....	95
4.3.1.	Competitive occupation of boron and aluminum in MFI unit-cell	
	98	
4.3.2.	Materials synthesis	103

4.3.3.	Materials characterization	104
4.3.4.	Study on aluminum distribution via catalytic tests.....	114
4.3.5.	Impact of aluminum distribution on Methanol to Hydrocarbons (MTH) reactions	123
4.4.	Conclusion and perspectives.....	130
4.5.	Reference.....	132
Chapter 5	“Ab-initio” synthesis of zeolites for catalytic reactions.....	136
5.1.	Introduction.....	137
5.2.	Ethylbenzene (EB) related chemical processes	139
5.2.1.	Materials synthesis and characterization.....	142
5.2.2.	Catalytic evaluation.....	148
5.3.	Methanol to Olefin reactions	156
5.3.1.	Understanding of the reaction mechanism	156
5.3.2.	OSDA selection for zeolite synthesis	159
5.3.3.	Materials synthesis, characterizations and catalytic evaluations	164
5.3.4.	Insights into reaction mechanisms.....	189
5.3.5.	Structure-performance relationship in MTO catalysts	198
5.3.6.	Directing selection of catalysts: ITQ-3 zeolite	209
5.4.	Conclusions and perspective.....	215
5.5.	Reference.....	217
	General conclusions and perspectives.....	220