

## Catalysis by Intrazeolite Encapsulated Inorganic Complexes

CATALYST	SOLVENT	OXIDISING AGENT	SUBSTRATES	REF
Fe -picolinate-Y	-	H <sub>2</sub> O <sub>2</sub>	Alkanes	1
Fe-2-pyridine carbaxamide-Y	-	H <sub>2</sub> O <sub>2</sub>	Alkanes	1
Mn-bipy-Y	Acetone	H <sub>2</sub> O <sub>2</sub>	Cyclohexene	2
Mn-tacn-Y	Acetone	H <sub>2</sub> O <sub>2</sub>	Cyclohexane	2
Fe-8-hydroxy quinolinol-MCM-41	Water	H <sub>2</sub> O <sub>2</sub>	Phenol (hydroxylation)	3
Mn-tmtacn-Y	Acetone	H <sub>2</sub> O <sub>2</sub>	Cyclohexene	2
Cu-Cl <sub>16</sub> -Pc-X	water:acetonitrile	H <sub>2</sub> O <sub>2</sub>	Oxyhalogenation of various aromatics	4
Cu-tacn(Br <sub>2</sub> )-MCM-41	Acetone	H <sub>2</sub> O <sub>2</sub>	Styrene Cyclohexene	5
Fe-picolinate-Y Fe-2-pyridine carbaxamide-Y		TBHP	Alkanes Alkenaes	1
VO(bipy) <sub>2</sub> -Y		TBHP	Cyclohexene	6
VO(salen)-Y	Acetonitrile	TBHP	Cyclohexane	7
VO-hps-Y		TBHP	Cyclohexane	8
RuF <sub>10</sub> Pc-X	Acetone	TBHP	Cyclohexane	9
Cu-salen-Y	Methanol	TBHP	Norbornene 1-naphthol	10
Cr-salen-MCM-41	Acetonitrile	TBHP	1-Naphthaol	11
VO(pic) <sub>2</sub> -Y	Acetonitrile	TBHP	cyclohexene (-)carveol	12

Cu-Pc-Y	Acetonitrile	TBHP	styrene	13
Mn-salen-Y	Acetone	TBHP	styrene	5
Cr-Salen-MCM-41	Toluene	PhIO	Prochiral alkenes	14
Ru(TDCPP)(CO)(EtOH)-MCM-41	Dichloromethane	2,6 dichloro pyridine -N-oxide	alkenes	15
Mn-salen-Y	Dicholormethane	NaOCl	alkeness	16

TDCPP:-Meso-Tetrakis(2,6 -dichloro phenyl)Porphyrin; PC: Pthalocyanine

TMTACN:-Tetramethyl triaza cyclononane; PhIO: - Iodosobenzne

TACN:-Triaza cyclononane; HPS: N-(2-hydroxyphenyl) Salicylideneimine

1.P.A.Jacobs,G.Langouch,A.M.Vanbavel,M.Lablee,K.Gerrits, *Stud.Surf.Sci.Catal*,**101**, 811(1996).

2.N.Herron, G.D.Stucky, C.A.Tolman, *Inorg.Chem.Acta* **100**, 135(1985). D.E Devos, J. L.Meinershager, T.Bein, *Angew.Chem. Int.Ed.Engl* **35**, 2211(1996).

3.C.Liv, Y.Shan, X.Yang, X.Ye ,Y.Wu, *J.Catal*, **168**, 35(1997)

4 R.Raja, P.Ratanaswamy, *J.Catal.* **170**, 244(1997)

5.Y.V. Subbarao, D.E.D. Vas,T.Bein,P.A. Jacobs, *Chem.Comm*,355(1997)

6.P.A. Jacobs,P. Rouxhel, B.Z. Zhan,C.A. Tryllo, P.P. Knotsgerrits. *Topics in catalysis*, 4397(1996)

7.K.J..Balcus, A.K.. Khanmnamedura, K.M. Dixon, F.Bediou, *Appl.Catal* **143**, 159(1996)

8 I.W.C.E.Arends,R.A.Sheldon,*Stud.Surf.Sci.Catal* **110**, 103(1997)

9 K.J Balkus,M.Eissa,R.Levadv, *J.Am.Chem.Soc*, **117**, 10753(1995)

10.S.Koner,*Chem.Comm* 598(1998)

- 11.S Koner,K.Chaudhari,T.K.Das,S.Sivasanker, *J.Mol.Catal A Chemical* **150**, 295(1999).
- 12.A.Kozlov,K.Asakura,Y.Iwasawa, *Microporous and Mesoporous Materials* **21**, 571 (1998)
- 13..S.Seelan, A..K.Sinha,D.Srinivas,S.Sivasankar,*J.Mol.Catal A,Chemical* **157**, 163(2000)
- 14..P.Satra, D.Brunel, *Chem.Comm*, 2485(1996)
- 15.C.J.Liu, W.Y.Yu , S.A.Li, C.M.Che, *J.Org.Chem*,**63**, 7364(1998).
- 16.S.B.Ogunumi,T.Bein, *Chem.Comm*, 901(1997).

**Oxyhalogenation Of Various Aromatic Compounds:Comparison Of Catalysts (J.Catalysis,170,244 (1997)).**

Cat	Substrate	Halogen Source	Oxidant	TOF	Conv. (%)	1	2	3	4	5	6	7	8	9	10
A	Toluene	HCl	H <sub>2</sub> O <sub>2</sub>	0.32			100								
B	Toluene	HCl	H <sub>2</sub> O <sub>2</sub>	8.92		45	17	15.7	10.7	2.6	9.0				
C	Toluene	HCl	H <sub>2</sub> O <sub>2</sub>	309.3		40.4	30.3	17.4	9.6	2.3					
D	Toluene	HCl	H <sub>2</sub> O <sub>2</sub>	2.19		21.2	47	8.3	5.5	18					
E	Toluene	HCl	H <sub>2</sub> O <sub>2</sub>	99.4		45.0	9.0	18.2	7.5	2.2	18.1				
C	Benzene	KCl	H <sub>2</sub> O <sub>2</sub>		9.7							47.5	37	15.5	
	Aniline	KCl	O <sub>2</sub> -TBHP		9.7							64.0	30.0	6.0	
	Anisole	KCl	O <sub>2</sub> -TBHP		4.8							6.5	60.5	14.5	
	Resorcinol	KCl	O <sub>2</sub> -TBHP		28.5							59.0	30.5	10.5	

	Phenol	KCl	H <sub>2</sub> O <sub>2</sub>		21.2							42.0	32.0	26.0	
	Toluene	HCl	H <sub>2</sub> O <sub>2</sub>		31.5			14.5	6.5						78

**Halogenated Products(wt(%))**

1. Benzaldehyde 2. Benzyl alcohol 3. O-chloro toluene 4. P-chloro toluene 5. Benzaldehyde 6. Di and Trichloro toluene 7. Mono chloro products 8. Dichloro products 9. Tri chloro products 10.

Benaldehyde+Benzyl alcohol

A-CuPc B-CuCl<sub>16</sub>Pc C- CuCl<sub>16</sub>Pc-Na-Y D-Cu(NO<sub>2</sub>)<sub>4</sub>Pc E-Cu-(NO<sub>2</sub>)<sub>4</sub> Pc-Na-

**Reaction conditions :**

Temperature:-338K(323K for Phenol), Substrate:H<sub>2</sub>O<sub>2</sub>-3Moles, Duration:10hours O<sub>2</sub>Pressure-400psig (Benzene , Aniline , Anisole ) ,300psig (Toluene ,Phenol, Resorcinol)

**Hydroxylation of phenol: Comparison of Catalysts**(*J.Catal, 168.35(1997)*)

<b>Catalyst</b>	<b>solvent</b>	<b>pH</b>	<b>Phenol conv(%)</b>	<b>CAT (%)</b>	<b>HQ (%)</b>	<b>PBQ (%)</b>	<b>O<sub>2</sub> evolved(ml)</b>	<b>TOF</b>
<b>Fe-Qn-MCM-41</b>	<b>Water</b>	<b>1</b>	<b>20</b>	<b>58.2</b>	<b>40.9</b>	<b>0.9</b>	<b>5</b>	<b>14.1</b>
		<b>2</b>	<b>57.5</b>	<b>56.0</b>	<b>36.8</b>	<b>7.2</b>	<b>10</b>	<b>40.4</b>
		<b>4</b>	<b>53.2</b>	<b>56.3</b>	<b>38.6</b>	<b>5.1</b>	<b>9</b>	<b>37.2</b>
		<b>7</b>	<b>48.2</b>	<b>57.5</b>	<b>41.8</b>	<b>0.7</b>	<b>8</b>	<b>33.9</b>
		<b>9</b>	<b>8.5</b>	<b>57.9</b>	<b>42.5</b>	<b>0.0</b>	<b>15</b>	<b>6.0</b>
		<b>12</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>20</b>	<b>0</b>
<b>Fe-Qn-MCM-41</b>	<b>Acetonitrile</b>		<b>26.4</b>	<b>56.8</b>	<b>30.7</b>	<b>12.5</b>	<b>5</b>	<b>18.6</b>
<b>Fe-Qn-MCM-41</b>	<b>Acetone</b>		<b>3.5</b>	<b>56.3</b>	<b>20.1</b>	<b>23.6</b>	<b>1</b>	<b>2.5</b>
<b>Fe-Qn</b>	<b>Water</b>	<b>7</b>	<b>25.8</b>	<b>65.3</b>	<b>32.7</b>	<b>2.0</b>	<b>2.5</b>	<b>18.1</b>
<b>Fe(II)</b>	<b>Water</b>	<b>7</b>	<b>20.5</b>	<b>68.7</b>	<b>18.9</b>	<b>12.4</b>	<b>35</b>	<b>17.6</b>

**CAT-Catechol    HQ-Hydroquinone    PBQ-Para benzoquinone    Fe-Qn -Iron(II) 8-hydroxy quinolinol**

**Reaction conditions: Reaction time-6 hours**

**Temperature-323K**

**Phenol- 0.35M**

**H<sub>2</sub>O<sub>2</sub>-.0.35M**

**Catalyst-0.1g**