Supplementary Material (ESI) for New Journal of Chemistry

Supporting Information Available

Ruthenium cluster attachment.

Table S1. Experimental conditions and BET surface area measurements for materials incorporating the ruthenium clusters. * As-synthesised, ** After calcination.

Material	Mass of Silica (mg)	Mass of Cluster (mg)	Solvent	Reaction Conditions			Colour	BET Surface Area (m^2/g)
				Stir (days)	Reflux (days)	Et_3N (mL)		
MCM-48*	-	-	-	-	-	-	-	121
MCM-48**	-	-	-	-	-	-	-	1376
MCM-48/Ru_{10}-X								
1	150	48	CH_2Cl_2	2	-	-	Grey	724
2	150	48	CH_2Cl_2	-	2	1	Grey	230
MCM-41*	-	-	-	-	-	-	-	90
MCM-41**	-	-	-	-	-	-	-	1000
MCM-41/Ru_3-X								
1	310	200	CH_2Cl_2	3	-	-	Cream	1027
2	401	199	CH_2Cl_2	3	-	4	Grey	344
3	756	251	CH_2Cl_2	2	-	5	Brown	159

Figure S1. TEM images of MCM-48/Ru_{10}-1 **A** BFTEM image **B** HRTEM image **C** FFT image with spots highlighted. These spots (at ~0.23nm and ~0.20nm) are consistent with the {1000} and {11-20} planes of Ru.

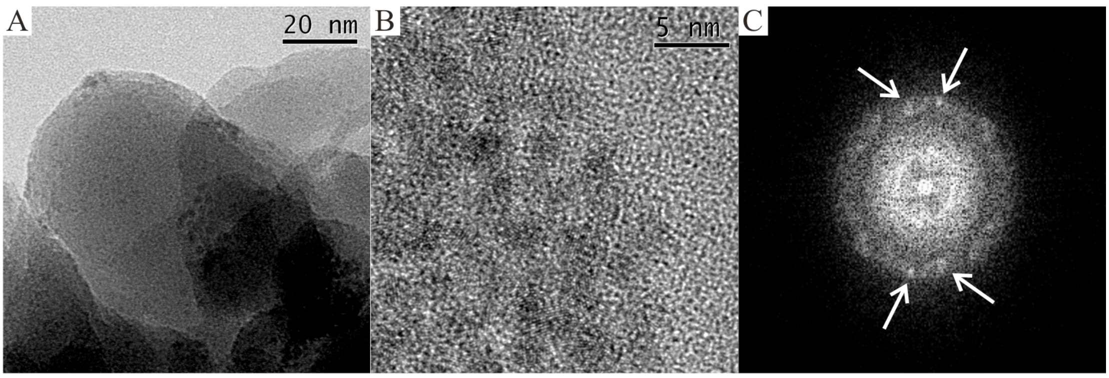
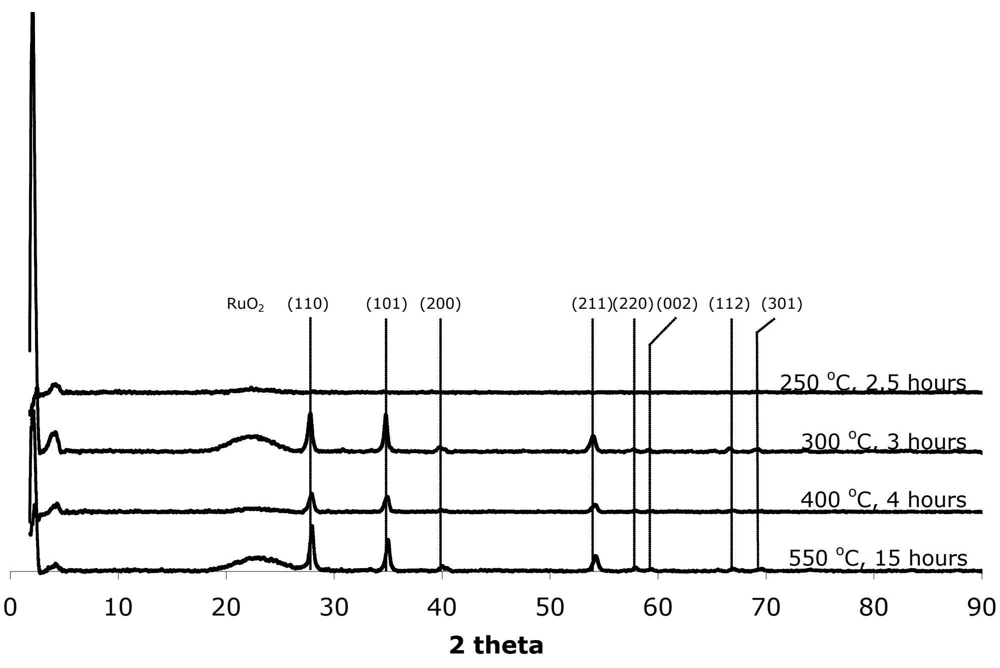


Figure S2. Powder XRD patterns of MCM-41/Ru3-2 after calcinations at various temperatures.



Bimetallic Cluster Attachment.

Table S2. Experimental conditions and BET surface area measurements for materials incorporating the copper-iron clusters. * As-synthesised, ** After calcination, ^ Sonicated for 2 days.

Material (X =)	Mass of Silica (mg)	Mass of Cluster (mg)	Solvent	Reaction Conditions			Colour	BET Surface Area (m^2/g)
				Stir (days)	Reflux (days)	Et_3N (mL)		
MCM-48*	-	-	-	-	-	-	-	121
MCM-48**	-	-	-	-	-	-	-	1376
MCM-48/Cu_6Fe_4-X								
1	200	100	CH_2Cl_2	3	-	-	Cream	1062
2	200	100	CH_2Cl_2	-	3	-	Cream	1058
3	200	100	CH_2Cl_2	3	-	1	Yellow	661
4	200	100	CH_2Cl_2	-	3	1	Pink	453
5	200	100	THF	-	3	1	Pink	919
6	200	100	Et_2O/CH_2Cl_2	-	3	1	Cream	1069
7	200	100	THF	-	3	1	Pink	959
8	200	133	THF	-	3	1	Pink	960
9	100	100	THF	-	3	1	Pink	766
10	200	133	THF	-	1	1	Pink	1198
11	200	133	THF	-	7	1	Pink	1401
12	202	133	THF	2^	-	1	Yellow	820

Table 4.3 BET surface area measurements for materials incorporating the copper-iron clusters. * As-synthesised, ** After calcination, ^ Sonicated for 2 days.

Figure S3. Powder XRD patterns of the materials with incorporated cluster $[(dppe)_2Cu][Cu_6Fe_4(CO)_{16}]$. The Cu reflections are labeled.

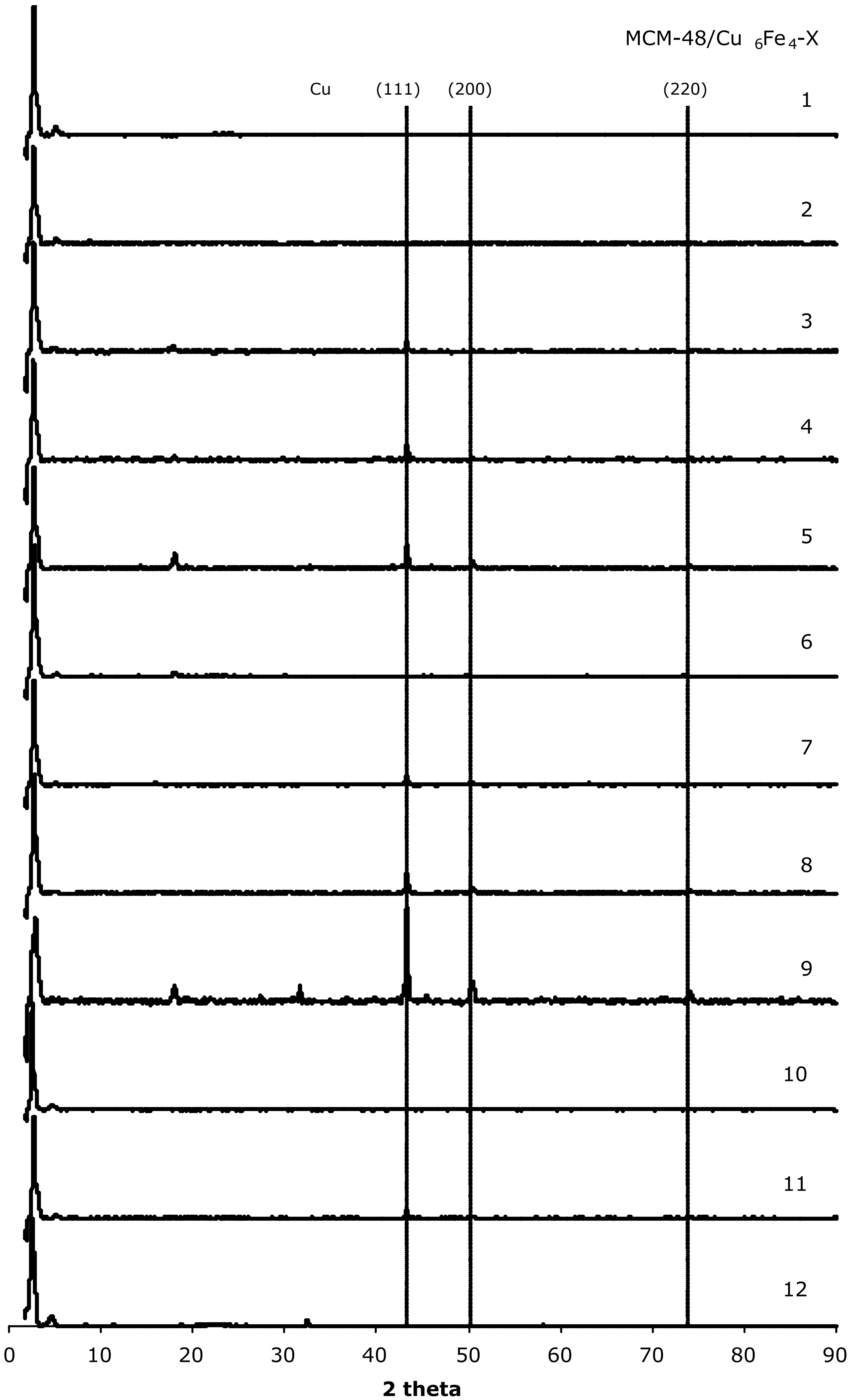

MCM-48/Cu 6Fe4-X
Cu
(111)
(200)
(220)
1
2
3
4
5
6
7
8
9
10
11
12
0
10
20
30
40
50
60
70
80
90
2 theta

Figure S4. **A** TEM image of MCM-48/Cu_6Fe_4-8 with well ordered porous material **B** TEM image of MCM-48/Cu_6Fe_4-8 with a copper particle. **C** TEM image of MCM-48/Cu_6Fe_4-11 with a copper particle.

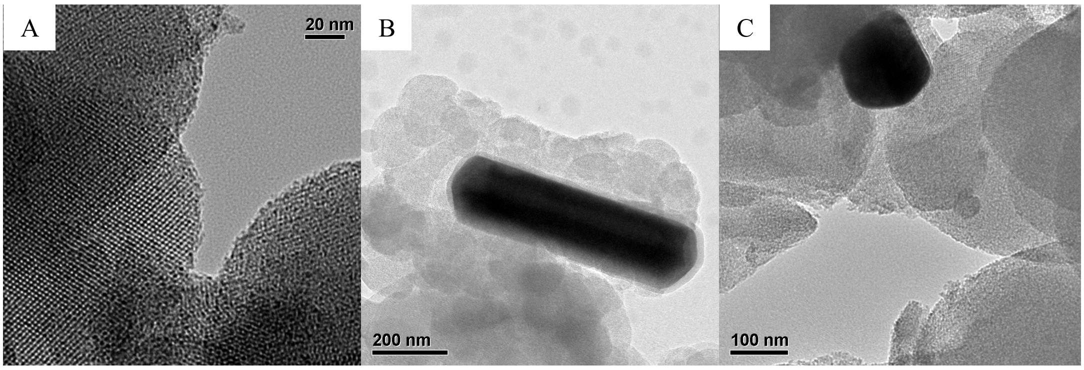


Table S3. Calcination conditions and BET surface areas of materials containing the Cu_6Fe_4 unit.

Original Material	BET SA (m^2/g)	Calcination Conditions			Calcined Material	BET SA (m^2/g)	Difference
		Temp	Time	Atm			
MCM-48/Cu_6Fe_4-8	960	300	3	N_2	c(300)MCM-48/Cu_6Fe_4-8	1249	289
MCM-48/Cu_6Fe_4-8	960	400	4	air	c(400)MCM-48/Cu_6Fe_4-8	1083	123
MCM-48/Cu_6Fe_4-11	1401	300	3	N_2	c(300)MCM-48/Cu_6Fe_4-11	1375	-26

Figure S5. Powder XRD patterns of materials incorporating [(dppe)$_2$Cu][$Cu_6Fe_4(CO)_{16}$] in MCM-48 before and after calcination. Cu and CuO reflection labeled.

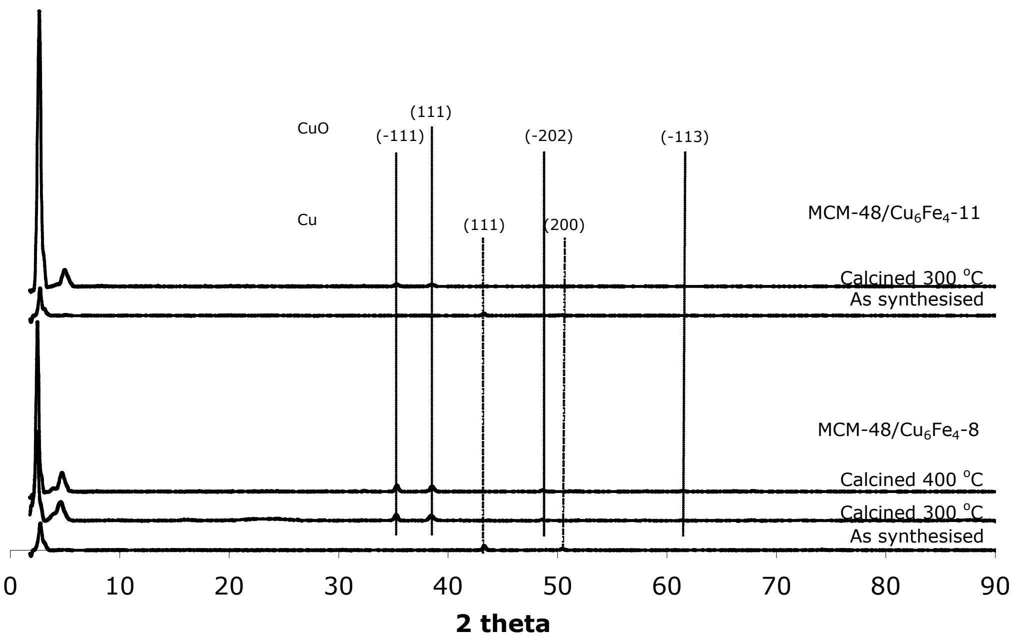
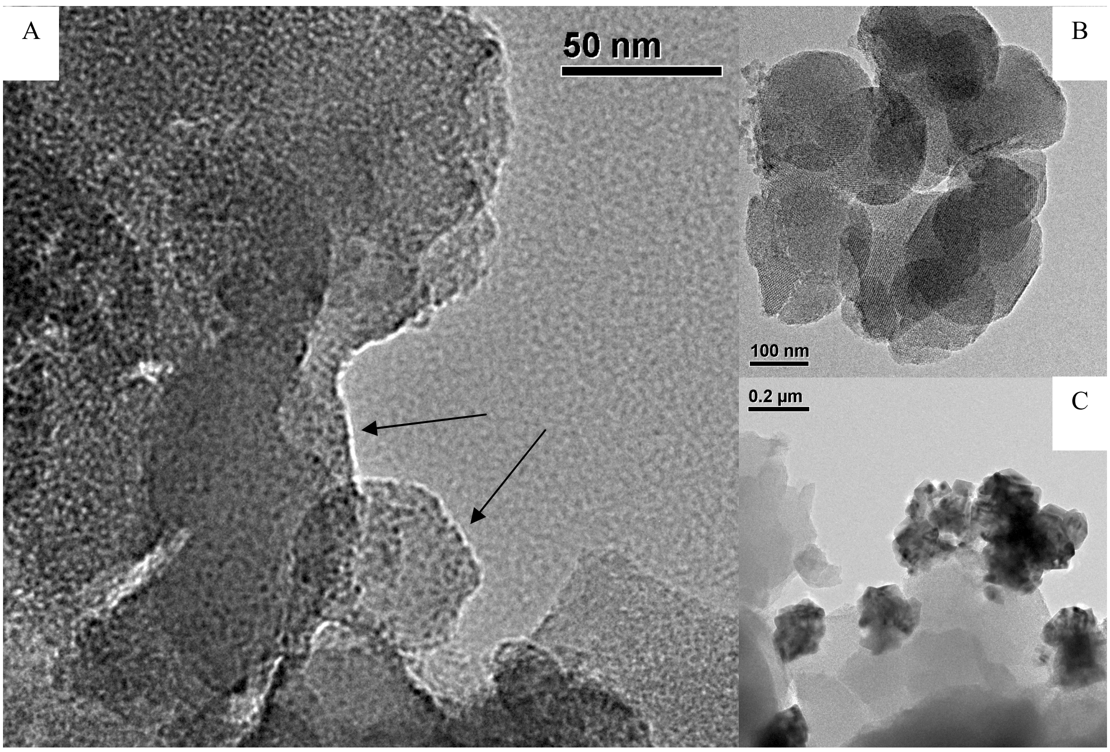


Figure S6. A TEM image of c(400)MCM-48/Cu_6Fe_4-8, with arrows showing location of possible small metal particles **B** TEM image of c(400)MCM-48/Cu_6Fe_4-8 **C** TEM image of c(300)MCM-48/Cu_6Fe_4-11, with large amounts of aggregated metal.



FePt incorporated M41S Materials.

Table S4. Experimental conditions and BET surface area measurements for materials incorporating the FePt nanoparticles. * As-synthesised, ** After calcination.

Material	Mass of Silica (g)	Volume of Fe_xPt_y (mL)	Solvent	Stir (hours)	BET Surface Area (m^2/g)
MCM-48*	-	-	-	-	121
MCM-48**	-	-	-	-	1376
MCM-48/Fe_xPt_y-X					
MCM-48/$Fe_{20}Pt_{80}$-1	0.200	0.5	Hexane	1.5	1298
MCM-48/$Fe_{27}Pt_{73}$-1	1.745	2.0	Hexane	1.5	487
MCM-48/$Fe_{40}Pt_{60}$-1	1.192	0.9	Hexane	1.5	716
MCM-41*	-	-	-	-	90
MCM-41**	-	-	-	-	1000
MCM-41/Fe_xPt_y-X					
MCM-41/$Fe_{20}Pt_{80}$-1	0.100	1.0	-	48	839
MCM-41/$Fe_{20}Pt_{80}$-2	0.200	0.3	Hexane	1.5	1019
MCM-41/$Fe_{20}Pt_{80}$-3	2.463	3.1	Hexane	1.5	854
MCM-41/$Fe_{20}Pt_{80}$-4	2.350	#	Dioctlyether	0.5	80
MCM-41/$Fe_{27}Pt_{73}$-1	2.013	2.0	Hexane	1.5	751
MCM-41/$Fe_{27}Pt_{73}$-2	0.514	0.7	Hexane	1.5	550
MCM-41/$Fe_{40}Pt_{60}$-1	2.027	1.5	Hexane	1.5	623
MCM-41/$Fe_{47}Pt_{53}$-1	1.992	3.0	Hexane	1.5	826
MCM-41/$Fe_{47}Pt_{53}$-2	0.498	1.4	Hexane	1.5	803
MCM-41/$Fe_{64}Pt_{36}$-1	0.937	0.9	Hexane	1.5	870

Figure S7. TEM images of c(400)MCM-41/$Fe_{20}Pt_{80}$-4.

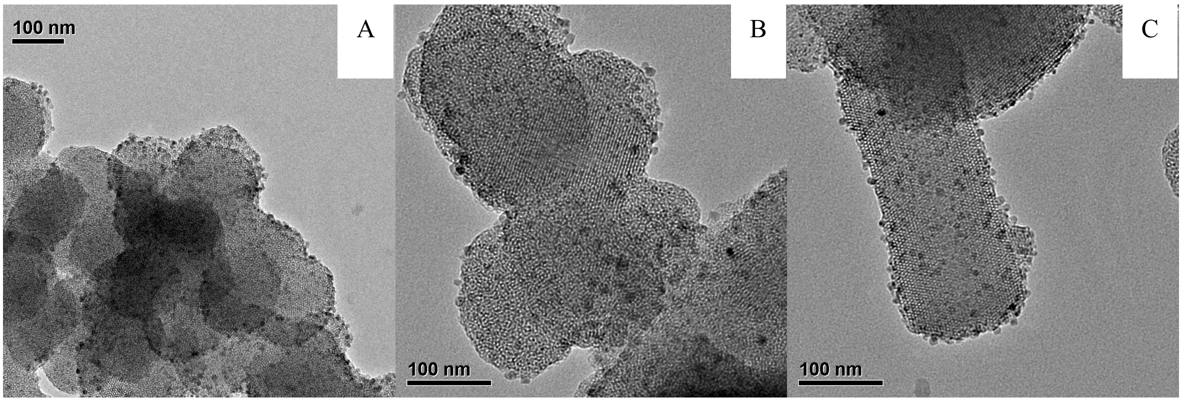


Figure S8. TEM images of tested catalysts **A** c(400)MCM-41/$Fe_{20}Pt_{80}$-3 **B** c(400)MCM-41/$Fe_{27}Pt_{73}$-1 **C** c(400)MCM-48/$Fe_{40}Pt_{60}$-1 **D** c(400)MCM-41/$Fe_{47}Pt_{53}$-2.

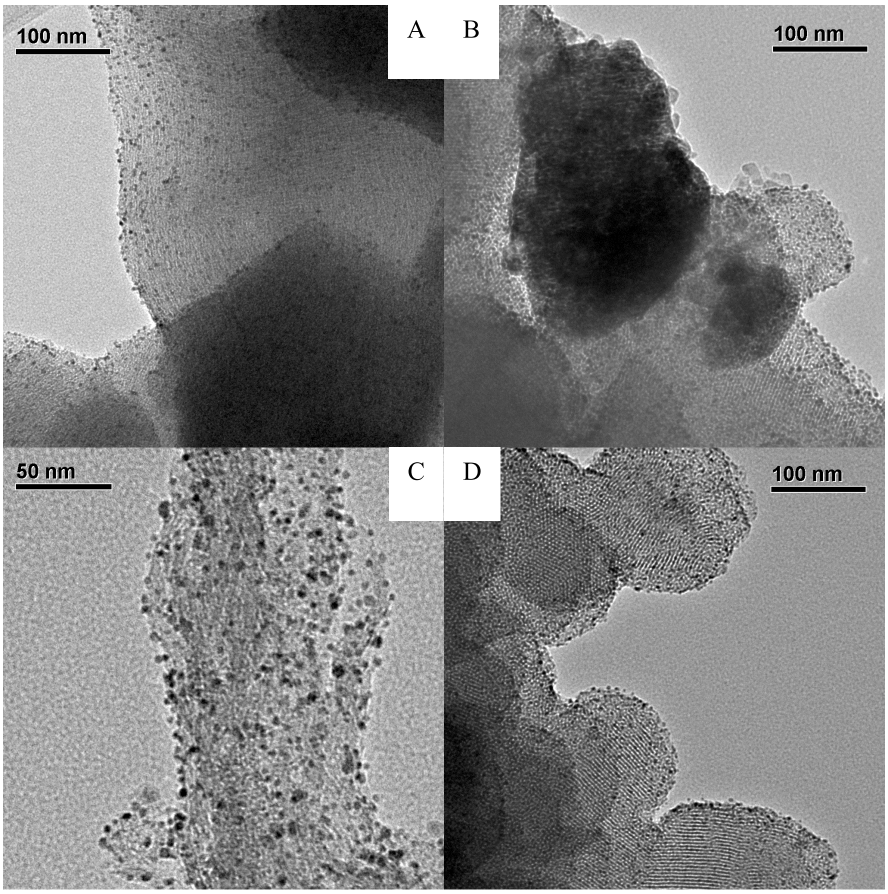


Figure S9. Gas Chromatogram of products formed during catalyst testing of c(300)MCM-48/Cu_6Fe_4-11. Blue = products at 100 ^oC, Red = products at 200 ^oC and Green = products at 300 ^oC.

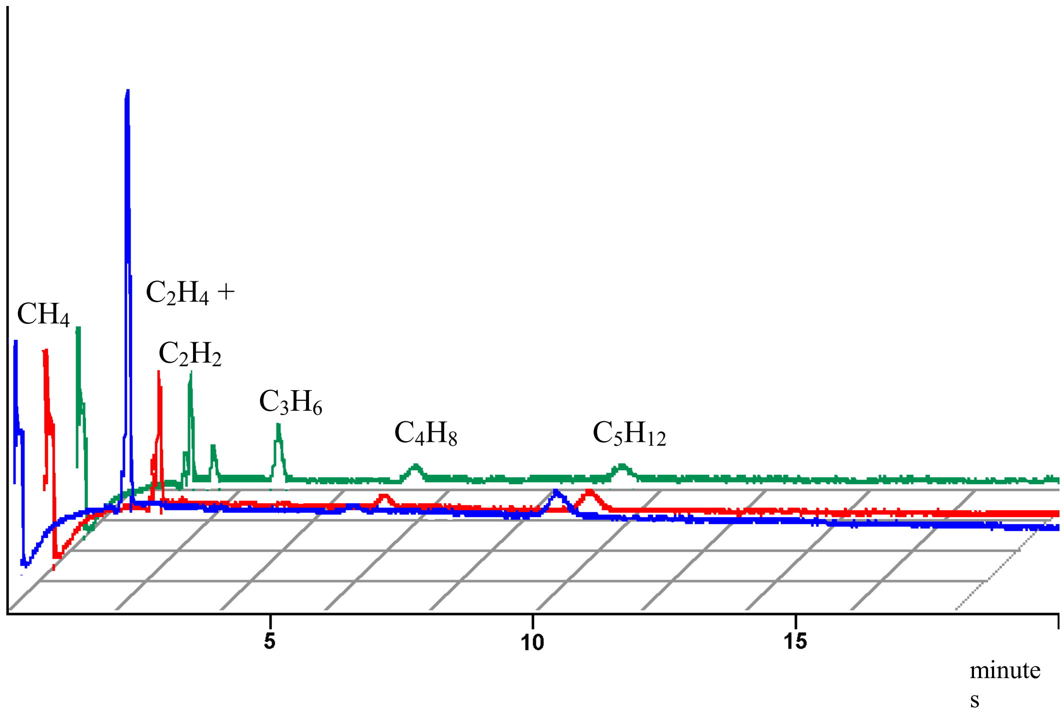


Figure S10. Gas Chromatogram of products formed during catalyst testing of c(250)MCM-41/Ru_3-2 in the glass reactor at 250 ^oC. Inset: Area 2 to 7 minutes in more detail.

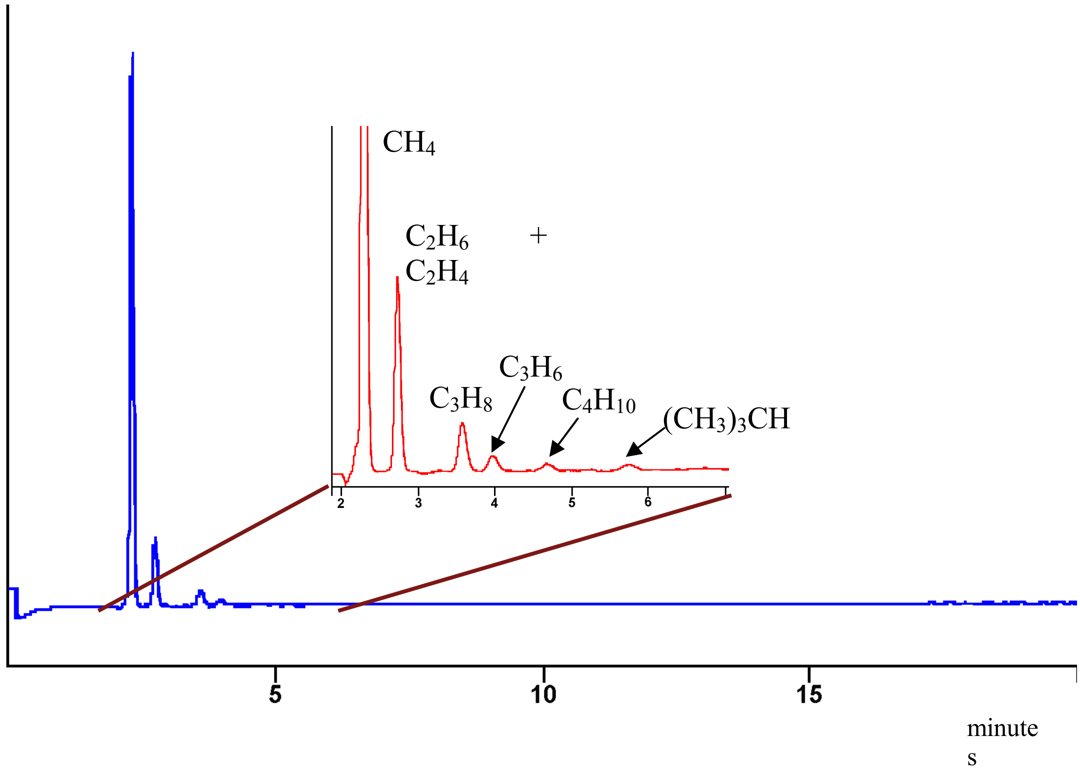


Figure S11. Gas Chromatogram of products formed during catalyst testing of c(400)MCM-41/$Fe_{20}Pt_{80}$-3 in the stainless steel reactor (T = temperature, N = normal conditions, P@X = pressurised to X kPa).

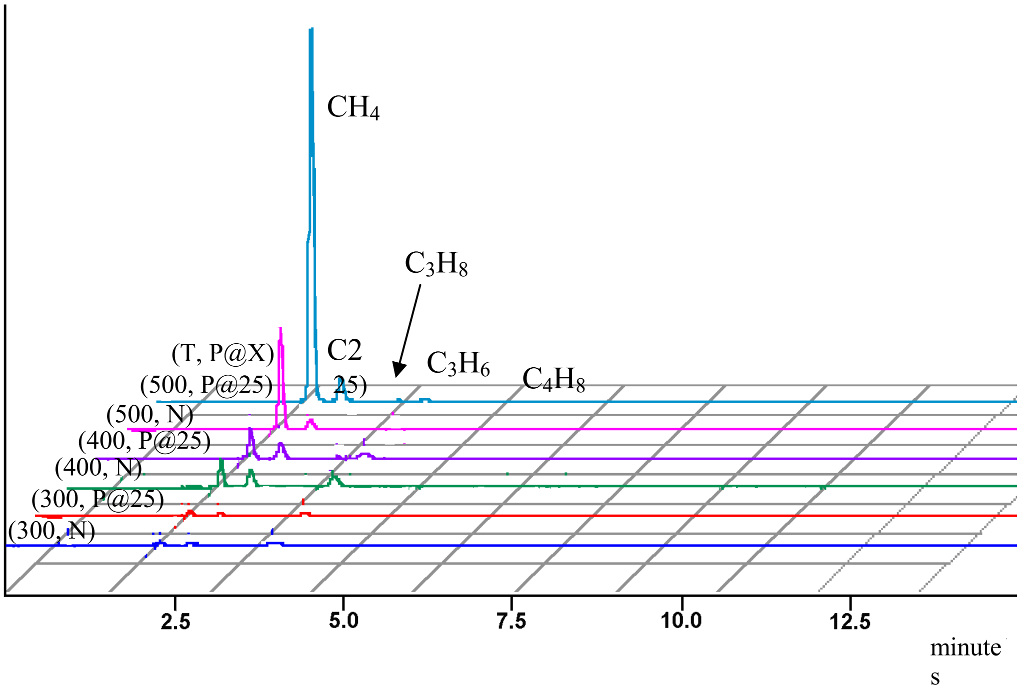


Figure S12: EDS spectrum obtained is STEM mode confirming the presence of Ru in Ru3-MCM-41 material.