Suplementary Information

New Journal of Chemistry

(Manuscript ID NJ-ART-01-2020-00005)

Dinuclear cobalt complexes supported by biphenol and binaphthol-derived bis (salicylaldimine) ligands: Synthesis, characterization and catalytic application in *β*-enaminones synthesis from 1, 3-dicarbonyl compounds and Aliphatic amines

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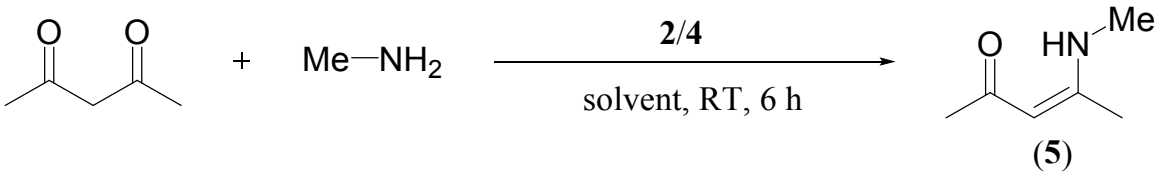
Table 1S. Solvent variation study for the β-enaminone reaction of acetyl acetone and methyl amine as catalyzed by the dinuclear [CoL1]2 (2) and [CoL2]2 (4) complexes

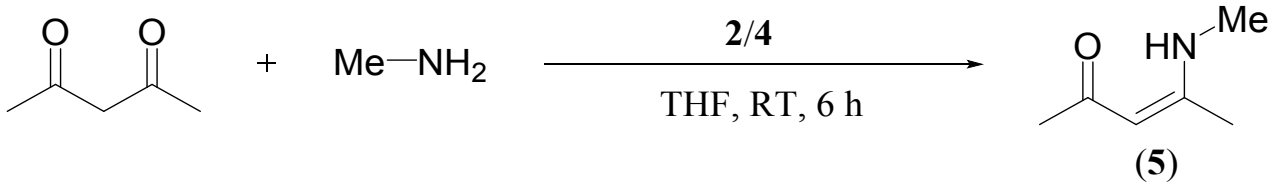


(**5**)

S.No	Solvent	Yield[b] (**2**)	Yield[b] (**4**)
1	$CHCl_3$	89	76
2	CH_2Cl_2	75	71
3	THF	93	89
4	DMSO	86	77
5	DMF	63	65

(*a*). Reaction conditions: 1.00 mmol of ketone, 4.0 mmol of amine, 1 mol % of catalyst (**2**/**4**), 2.5 mL of solvent at room temperature, stir for 6 h. (*b*) Isolated yields (%).

Table 2S. Time variation study for the β-enaminone reaction of acetyl acetone and methyl amine as catalyzed by the dinuclear [CoL1]2 (2) and [CoL2]2 (4) complexes.



(**5**)

S.No	Time (h)	Yield[b] (**2**)	Yield[b] (**4**)
1	0.5	63	59
2	2	78	63
3	4	83	78
4	6	93	89
5	12	90	85

(*a*). Reaction conditions: 1.00 mmol of ketone, 4.0 mmol of amine, 1 mol % of catalyst (**2**/**4**), 2.5 mL of THF at room temperature, stir for the given time. (*b*). Isolated yields (%).

Table 3S. Selected results of blank, control and mercury drop experiments for the β-enaminone reaction of acetyl acetone and methylamine as catalyzed by the dinuclear [CoL1]2 (2) and [CoL2]2 (4) complexesa.

(**5**)

S.No	Catalyst	Yield[b]	Hg/Yield[b]
1	(**2**)[a]	93	90
2	(**4**)[a]	89	87
3	-	40	
4	$Co(OAc)_2 \cdot 4H_2O$	42	
5	H_2L^1 (**1**)	64	
6	H_2L^2 (**3**)	67	

(*a*). Reaction conditions: 1.00 mmol of ketone, 4.0 mmol of amine, 1 mol % of catalyst (**2/4**) or 2 mol % of $Co(OAc)_2 \cdot 4H_2O/H_2L^1/H_2L^2$, 2.5 mL of THF at room temperature, stir for 6 h. (*b*). Isolated yields (%).

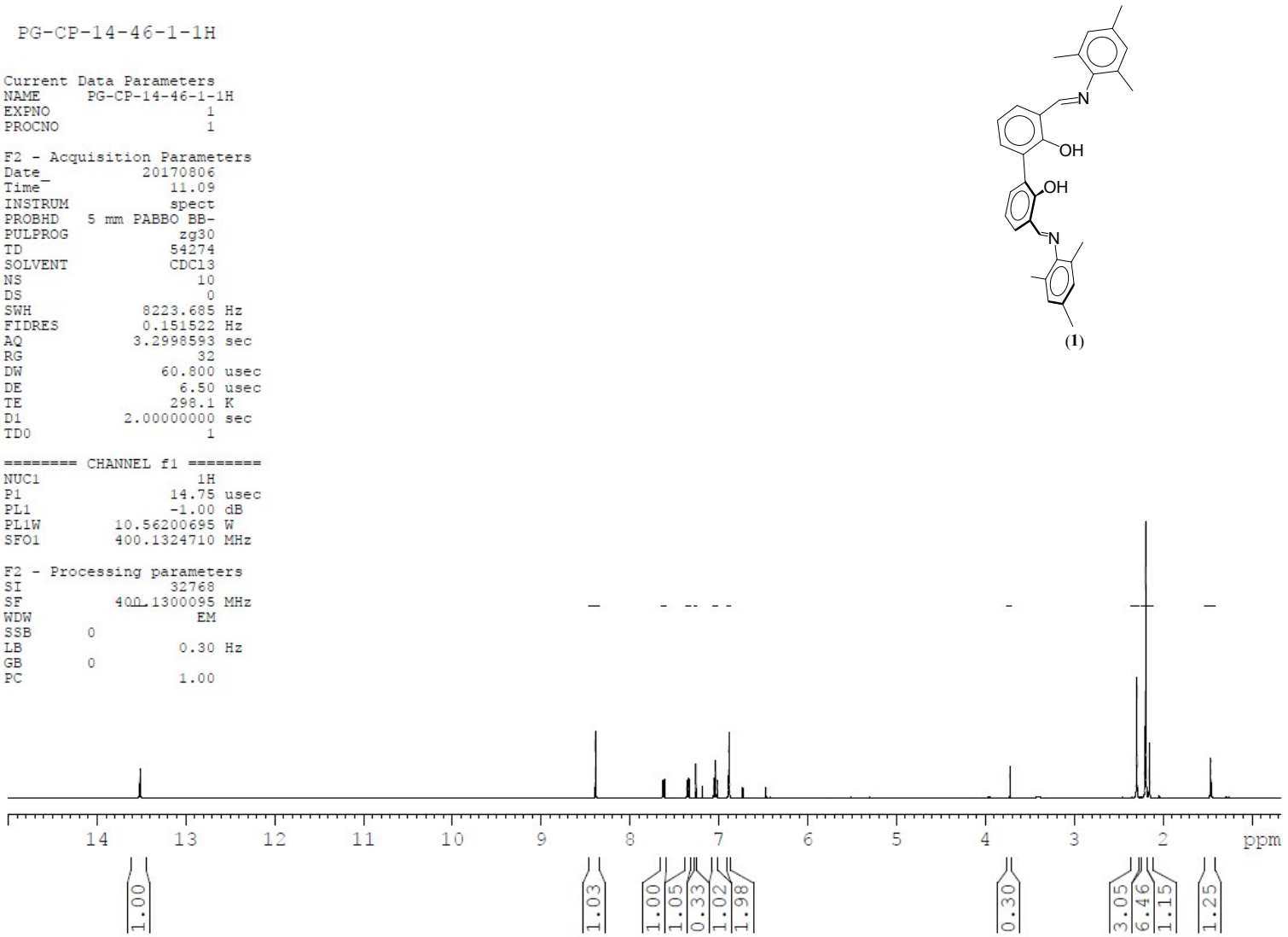


Fig. S1 1H NMR spectrum of **1** in CDCl3.

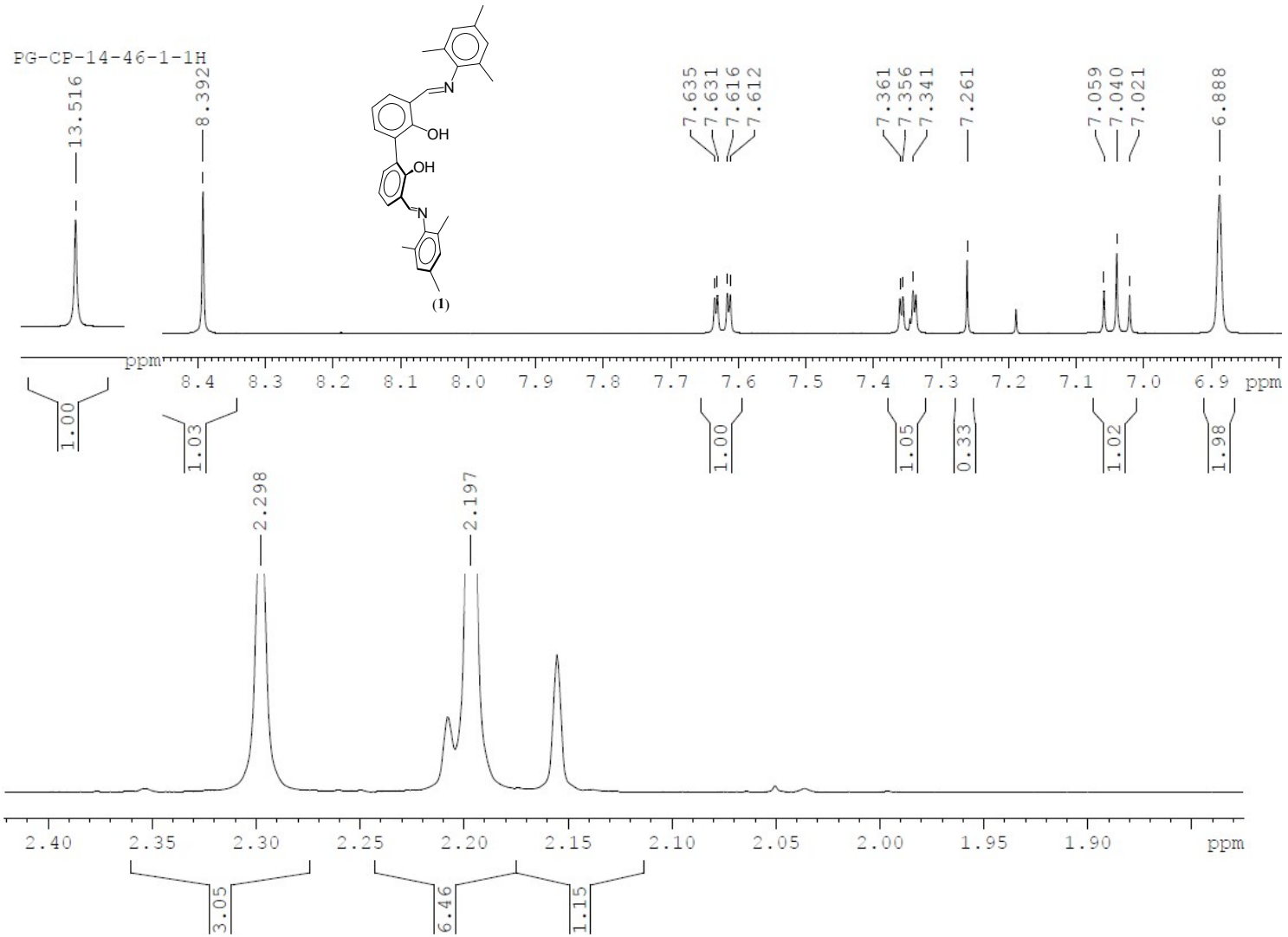


Fig. S2 Expanded 1H NMR spectrum of **1** in $CDCl_3$.

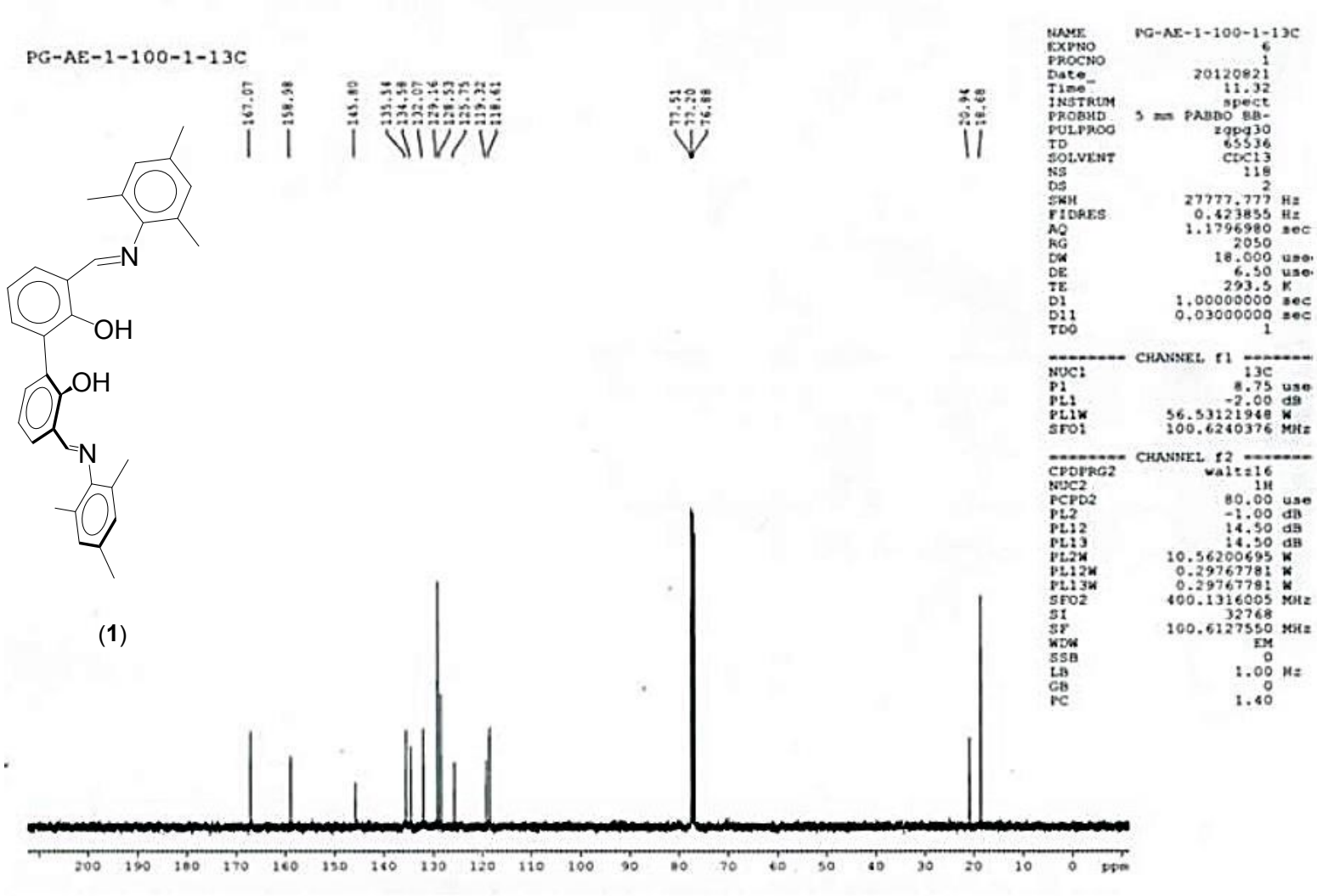


Fig. S3 $^{13}C\{1H\}$ NMR spectrum of **1** in $CDCl_3$.

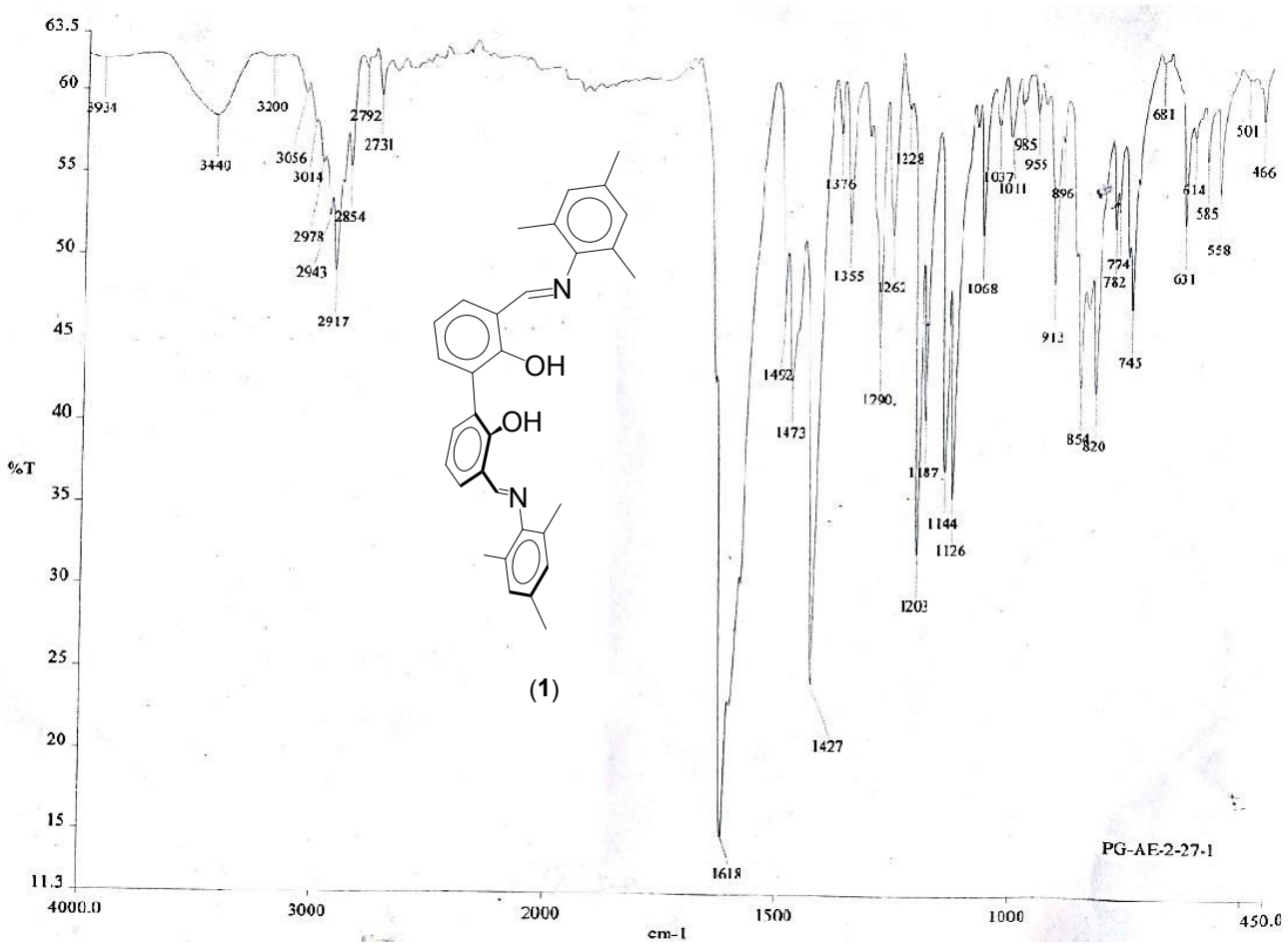
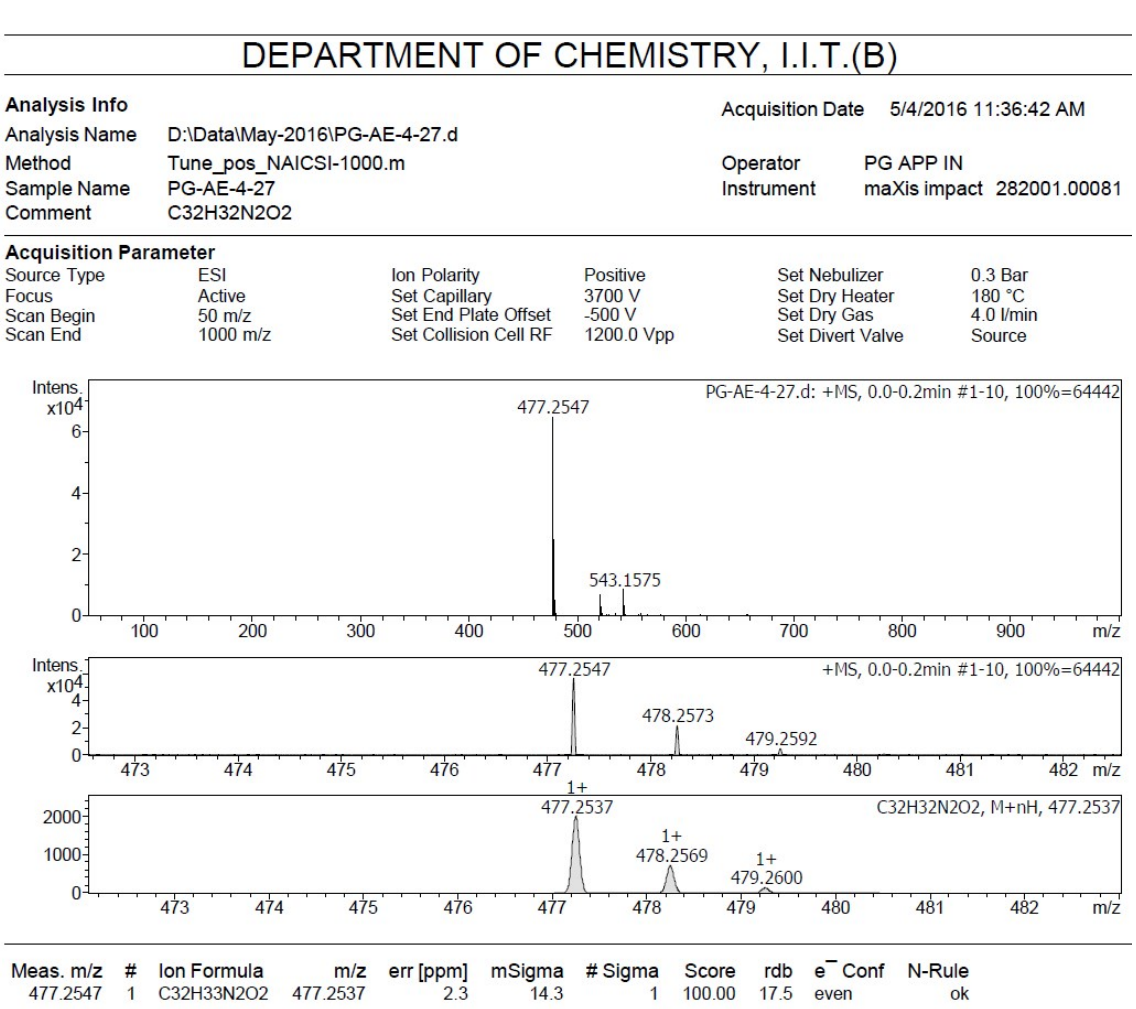
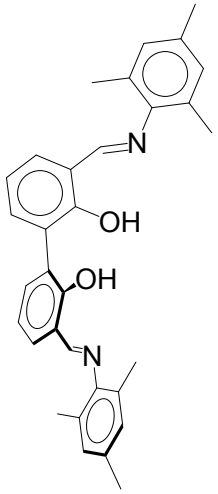


Fig. S4 Infrared spectrum of **1** in KBr.





(**1**)

Fig. S5 High Resolution Mass Spectrometry (HRMS) data of **1**.

Eager 300 Report

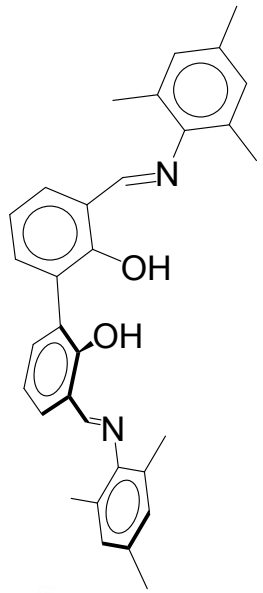
Page: 1 Sample: PG-AE-2-27-1 (PG-AE-2-27-1)

Method Name : PGCP16052016
Method File : D:\CHNS2016\PGCP16052016.mth
Chromatogram : PG-AE-2-27-1
Operator ID : CHANDNI Company Name : C.E. Instruments
Analysed : 05/16/2016 12:53 Printed : 5/17/2016 10:26
Sample ID : PG-AE-2-27-1 (# 13) Instrument N. : Instrument #1
Analysis Type : UnkNown (Area) Sample weight : .751

Calib. method : using 'K Factors'

!!! Warning missing one or more peaks.

Element Name	%	Ret.Time	Area	BC	Area ratio	K factor
1	0.0000	2	31480	FU		0.0000
2	0.0000	6	99279	FU		0.0000
Nitrogen	5.9177	43	47966	RS	33.450400	.107929E+07
Carbon	80.8003	65	1604465	RS	1.000000	.264014E+07
Hydrogen	5.9919	178	336173	RS	4.772736	.705507E+07
Totals	92.7099		2119363			



(**1**)

Fig. S6 Elemental analysis data of **1**.

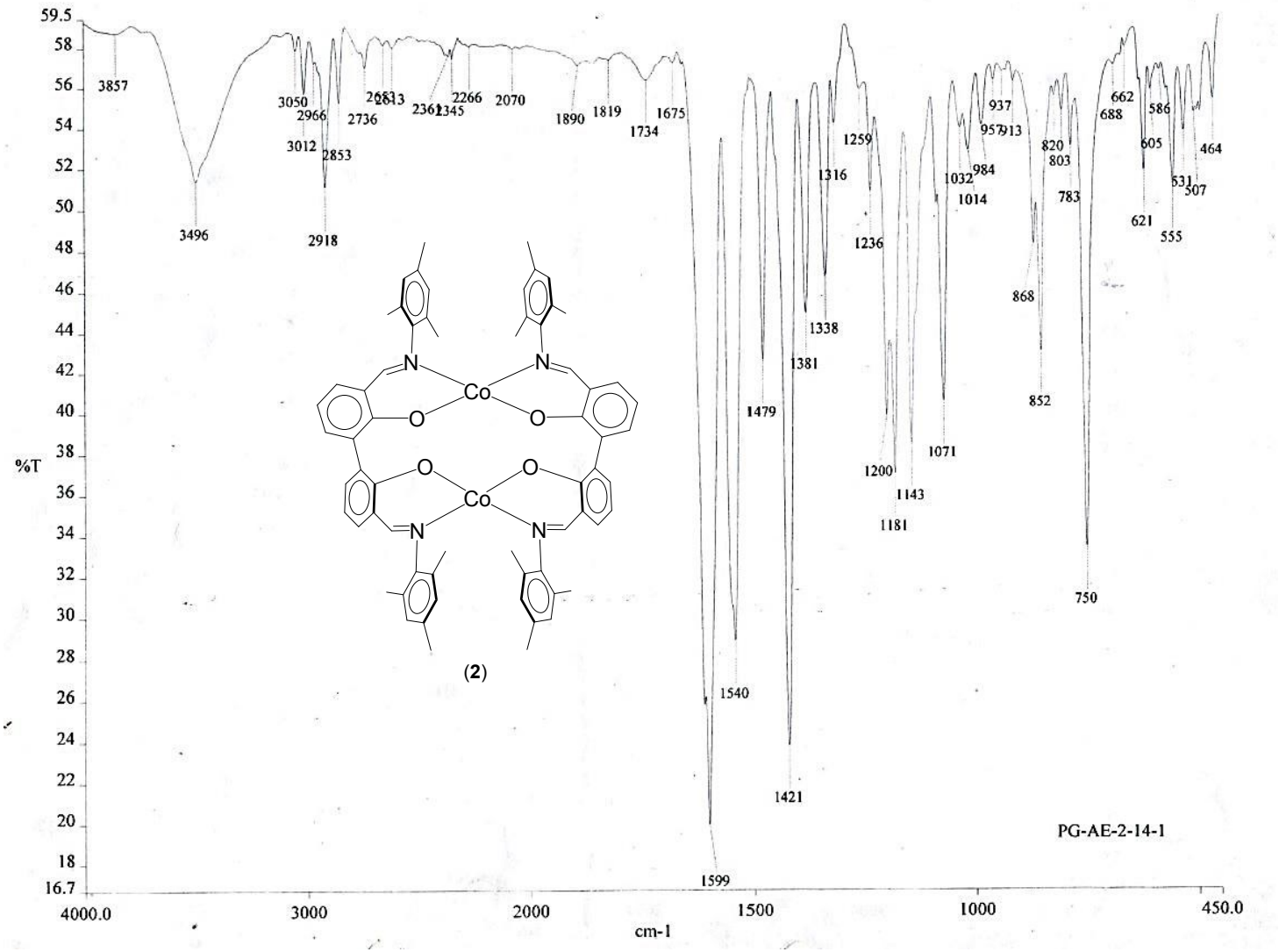


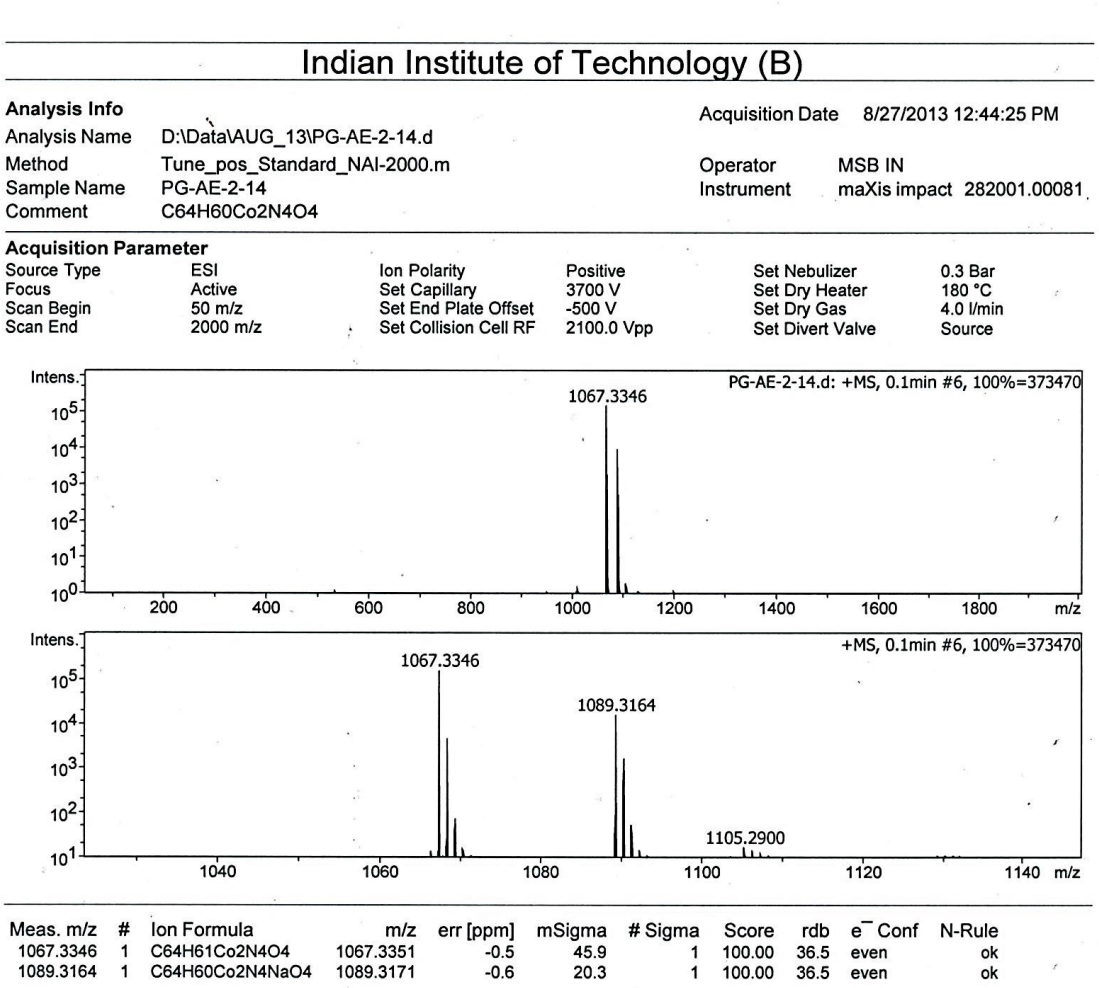
Fig. S7 Infrared spectrum of **2** in KBr.

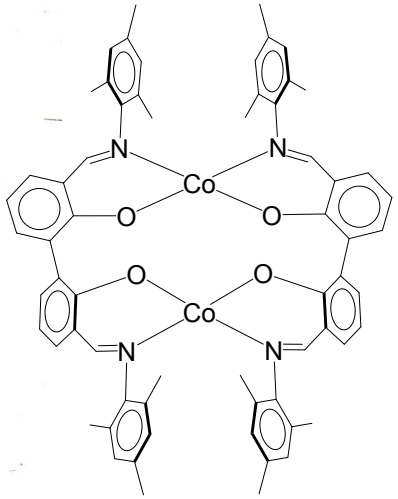
Table 4S. Important IR bands of 1(H_2L^1) and 3 (H_2L^2) dinucclear complexes **2** and **4**

Compound	$\nu_{(O–H)/H2O}$ (cm^{-1})	$\nu_{(C=N)}$ (cm^{-1})	$\nu_{(C–O)}$ (cm^{-1})	$\nu_{(C=C)}$ (cm^{-1})
H_2L^1(1)	3440	1618	1203	1427
2	3446	1599	1143	1421
H_2L^2 (3)	3386	1623	1255	1449
4	3451	1620	1254	1457

Table 5S. UV–Visible spectra of **1, 2, 3** and **4**

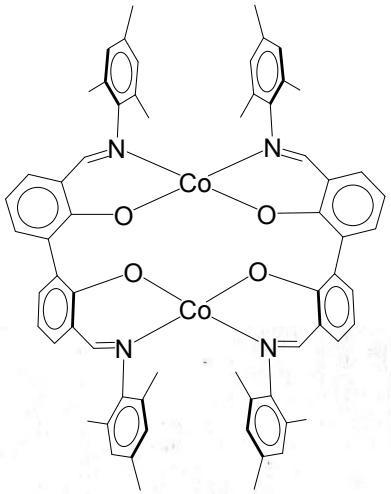
Compound	λmax, nm	absorbance	ε, $M^{-1}cm^{-1}$	transition
H_2L^1 (1)	236	3.5	52000	$\pi \rightarrow \pi^*$
	341	1.7	25000	$n \rightarrow \pi^*$
	230	1.22	18000	$\pi \rightarrow \pi^*$
2	280	0.54	8000	$n \rightarrow \pi^*$
	393	0.26	4000	$d \rightarrow \pi^*$
H_2L^2 (3)	244	0.23	3400	$\pi \rightarrow \pi^*$
	342	0.11	1600	$n \rightarrow \pi^*$
4	260	0.97	14000	$\pi \rightarrow \pi^*$
	306	0.33	4900	$n \rightarrow \pi^*$
	350	0.21	3100	$d \rightarrow \pi^*$





(**2**)

Fig. S8 High Resolution Mass Spectrometry (HRMS) data of **2.**



(2)

Eager 300 Report

Page: 1 Sample: PG-AE-2-31-1 (PG-AE-2-31-1)

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Method File	: D:\CHNS2012-13\SRM23092014.mth		
Chromatogram	: PG-AE-2-31-1		
Operator ID	: SONALI	Company Name	: C.E. Instruments
Analysed	: 09/23/2014 15:14	Printed	: 9/23/2014 19:31
Sample ID	: PG-AE-2-31-1 (# 18)	Instrument N.	: Instrument #1
Analysis Type	: UnkNown (Area)	Sample weight	: .926

Calib. method : using 'K Factors'

!!! Warning missing one or more peaks.

Element Name	%	Ret.Time	Area	BC	Area ratio	K factor
Nitrogen	5.3271	43	73812	FU	24.869010	.149634E+07
Carbon	72.1021	66	1835641	FU	1.000000	.274934E+07
Hydrogen	5.5911	181	374665	RS	4.899418	.697271E+07
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Fig. S9 Elemental analysis data of **2.**

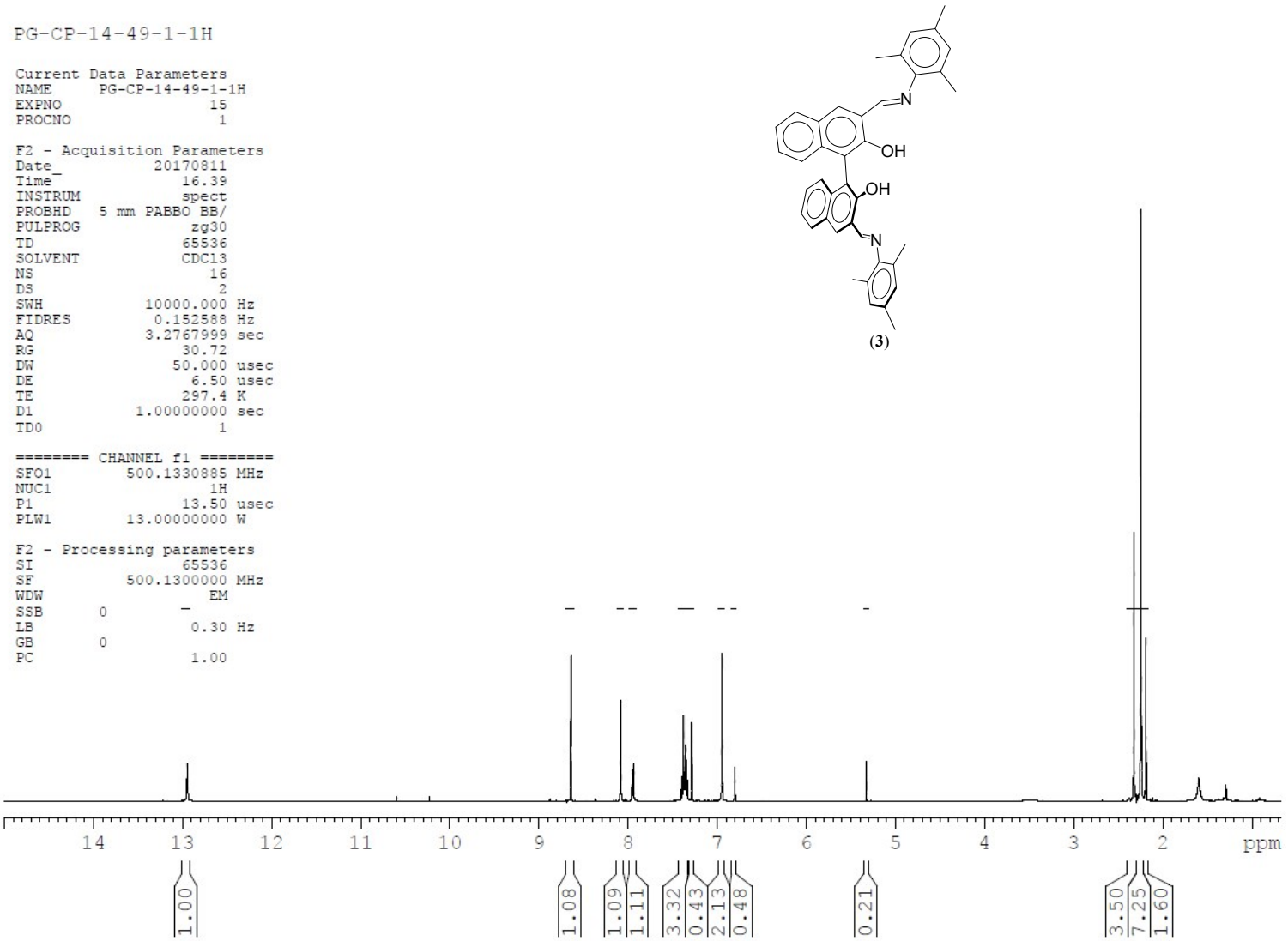


Fig. S10 ^{1}H NMR spectrum of **3** in $CDCl_3$.

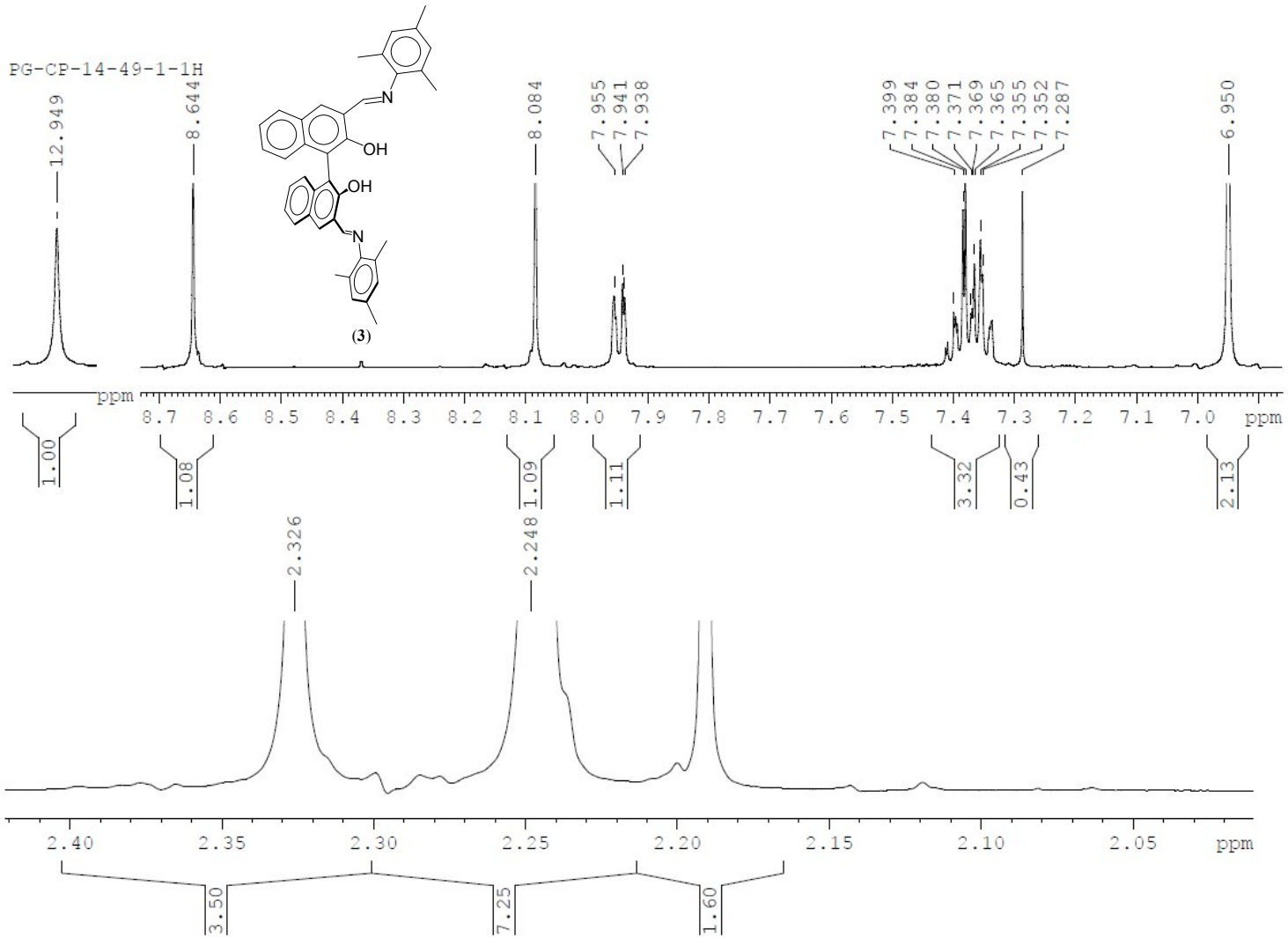


Fig S11 Expanded ^{1}H NMR spectrum of **3** in $CDCl_3$.

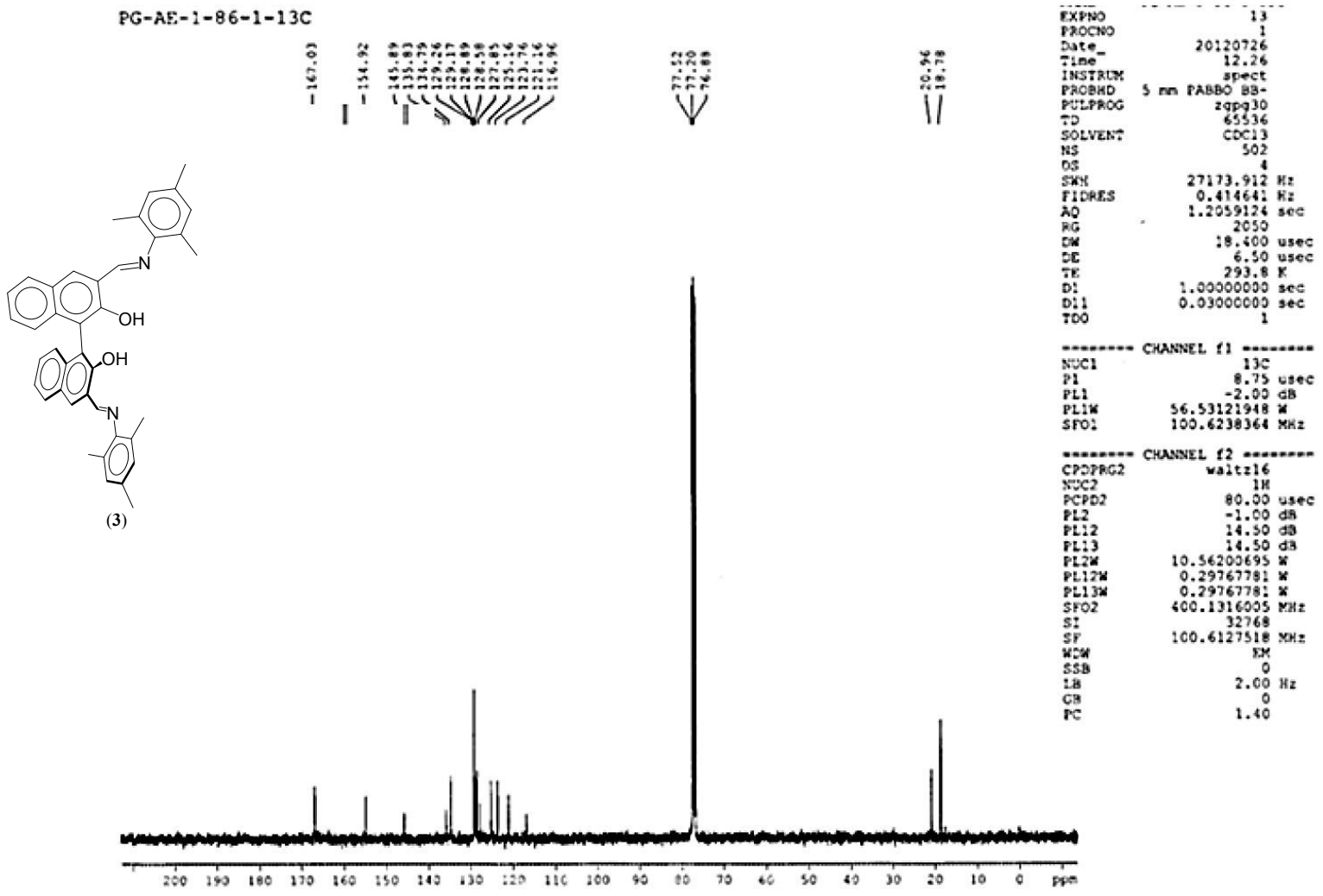


Fig. S12 $^{13}C\{^{1}H\}$ NMR spectrum of **3** in $CDCl_3$.

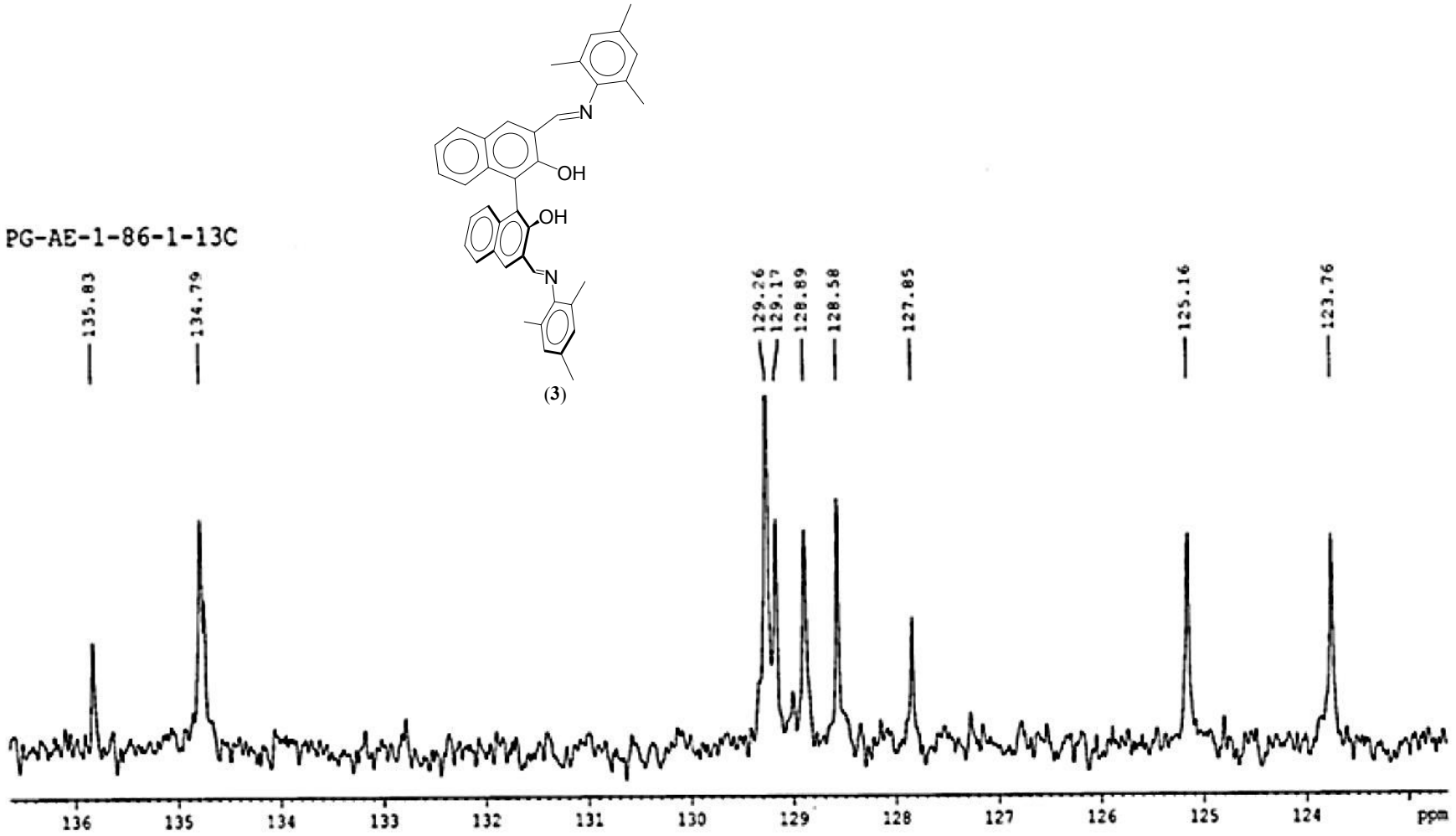


Fig S13 Expanded $^{13}C\{^{1}H\}$ NMR spectrum of **3** in $CDCl_3$.

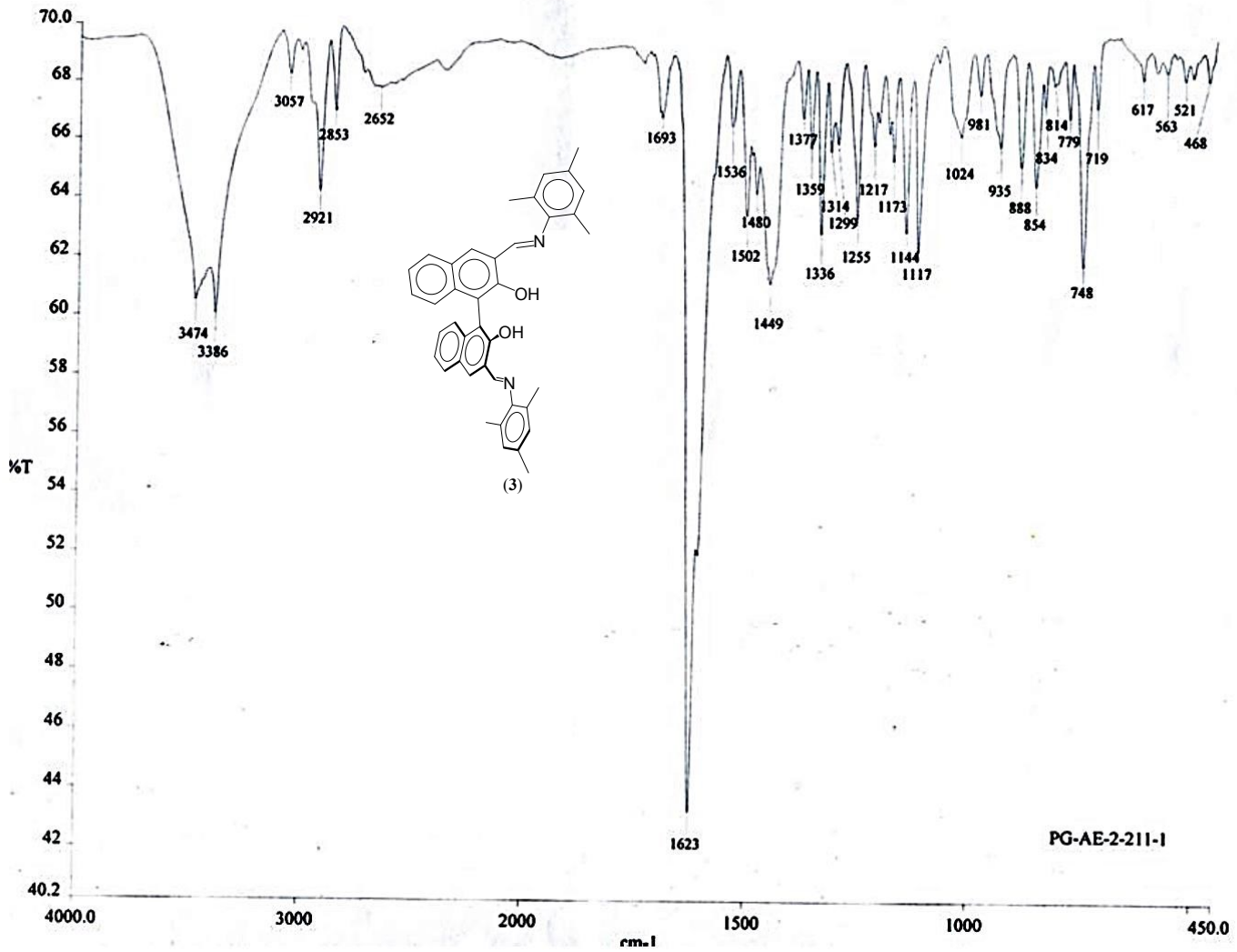
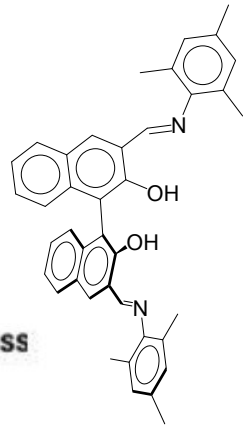


Fig.S14 Infrared spectrum of **3** in KBr.

Elemental Composition Report

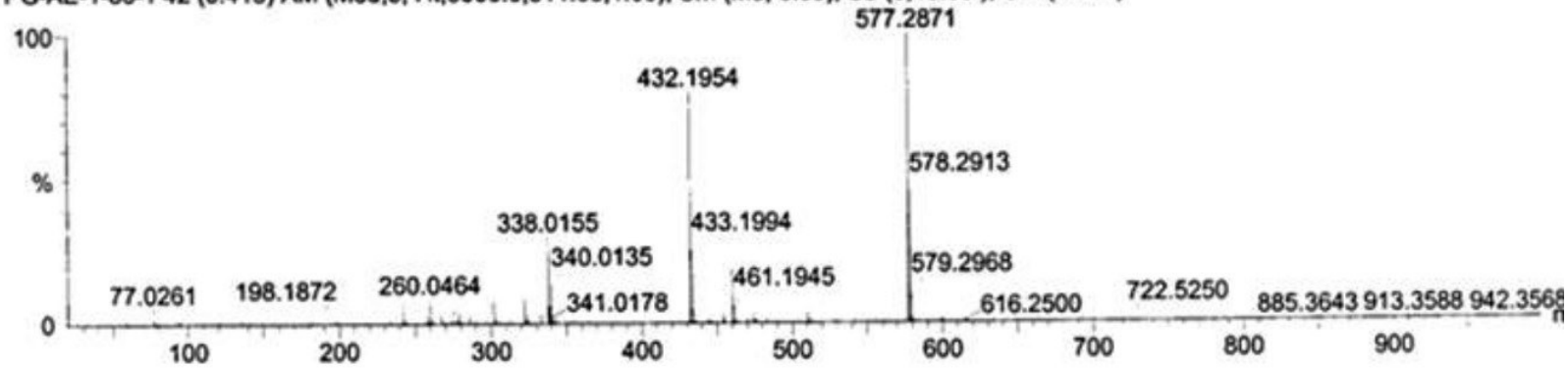
Single Mass Analysis (displaying only valid results)
Tolerance = 40.0 PPM / DBE: min = -1.5, max = 200.0
Isotope cluster parameters: Separation = 1.0 Abundance = 1.0%

Monoisotopic Mass, Odd and Even Electron Ions
30 formula(e) evaluated with 1 results within limits (up to 50 closest results for each mass



(3)

Micromass : Q-Tof micro (YA-105) Dept. Of Chemistry I.I.T.(B)
C40H36N2O2
PG-AE-1-86-1 42 (0.419) AM (Med,5, Ht,5000.0,311.08,1.00); Sm (Md, 6.00); Sb (5,40.00); Cm (4:101)

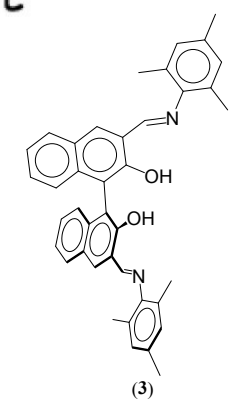


Minimum:				-1.5		
Maximum:		200.0	40.0	200.0		
Mass	Calc. Mass	mDa	PPM	DBE	Score	Formula
577.2871	577.2855	1.6	2.8	23.5	1	C40 H37 N2 O2

Fig. S15 High Resolution Mass Spectrometry (HRMS) data of **3.**

Eager 300 Report

Page: 1 Sample: PG-AE-1-86-2 (PG-AE-1-86-2)



(3)

Method Name : SP-230712
Method File : D:\CHNS2012\SP-230712.mth
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Analysis Type : UnkNown (Area)

Calib. method : using 'K Factors'

!!! Warning missing one or more peaks.

Element Name		Ret.Time	Area	BC	Area ratio	K factor
Nitrogen	4.5275	43	45902	RS	32.170660	905300.9000
Carbon	80.6678	67	1476682	RS	1.000000	.242139E+07
Hydrogen	6.6426	175	290366	RS	5.085596	.578213E+07
Totals	91.8379		1812949			

Fig. S16 Elemental analysis data of **3**.

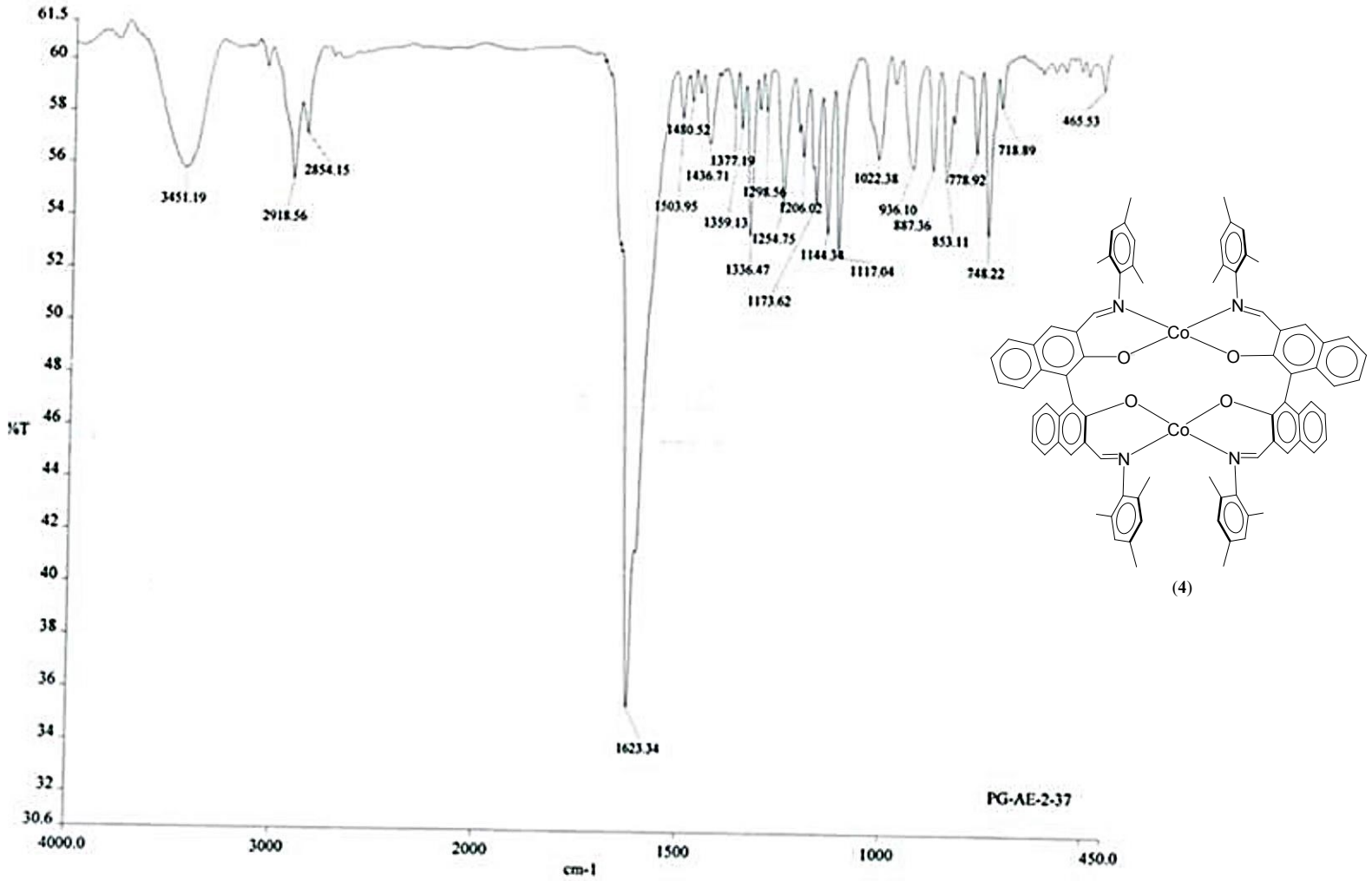
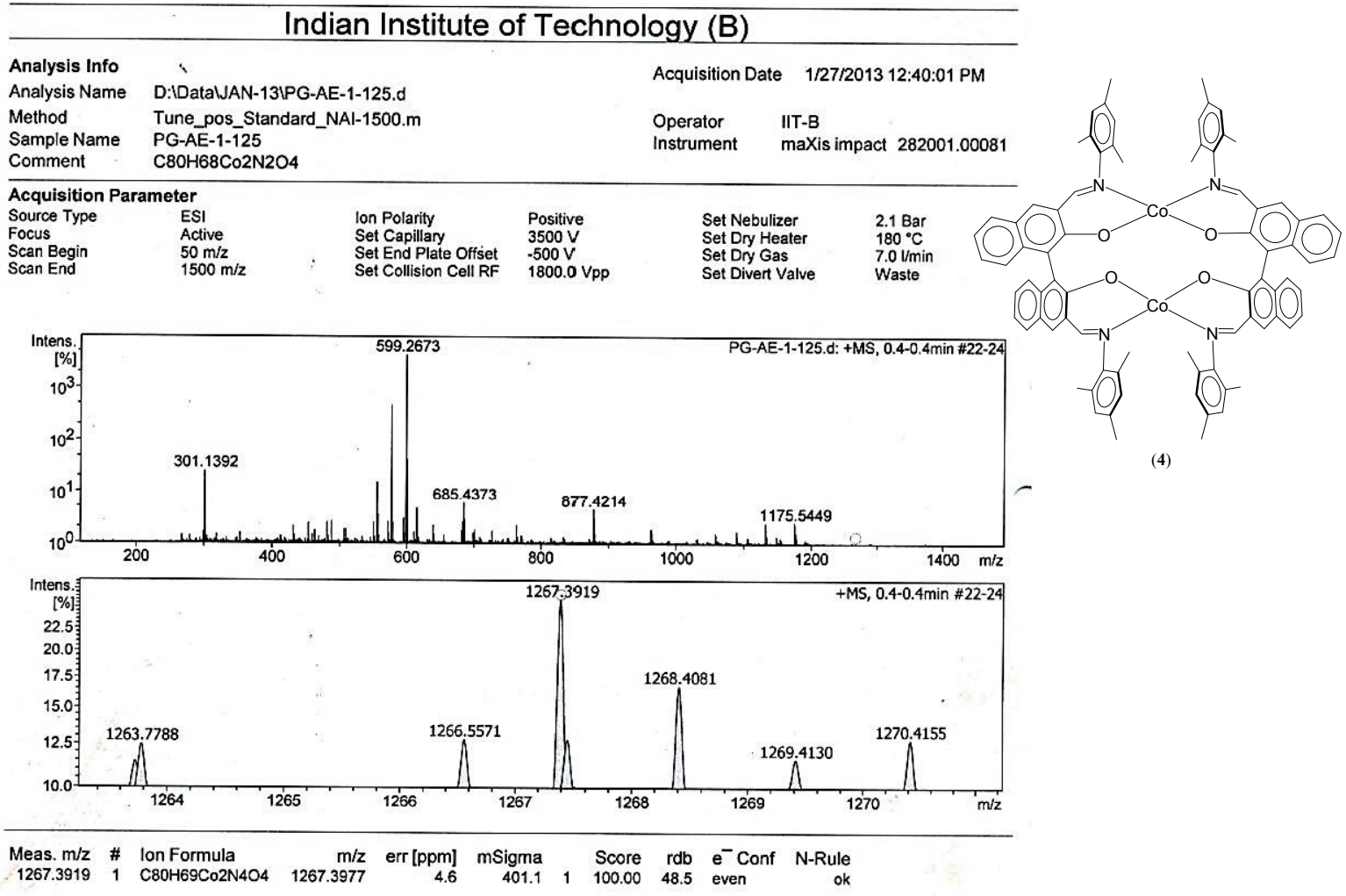
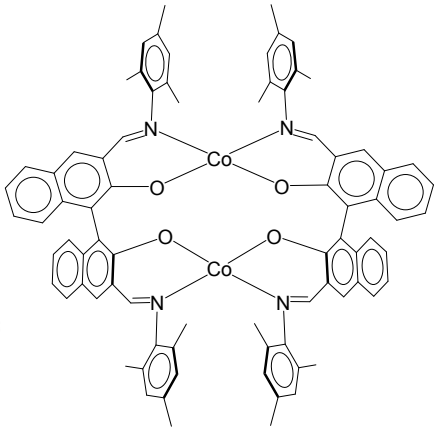


Fig. S17 Infrared spectrum of **4** in KBr**.**



(4)

Fig. S18 High Resolution Mass Spectrometry (HRMS) data of **4.**



(4)

Eager 300 Report

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Operator ID : CHANDNI
Analysed : 08/28/2017 17:47
Sample ID : PG-CP-14-60-1 (# 7)
Analysis Type : UnkNown (Area)

Company Name : C.E. Instruments
Printed : 8/28/2017 19:13
Instrument N. : Instrument #1
Sample weight : .856

Calib. method : using 'K Factors'

!!! Warning missing one or more peaks.

Element Name	%	Ret.Time	Area	BC	Area ratio	K factor
Nitrogen	4.8811	42	45575	RS	37.650750	.109078E+07
Carbon	76.5413	65	1715933	RS	1.000000	.261897E+07
Hydrogen	5.9255	181	326290	RS	5.258920	.643284E+07
Totals	87.3479		2087798			

Fig.S19 Elemental analysis data of **4.**

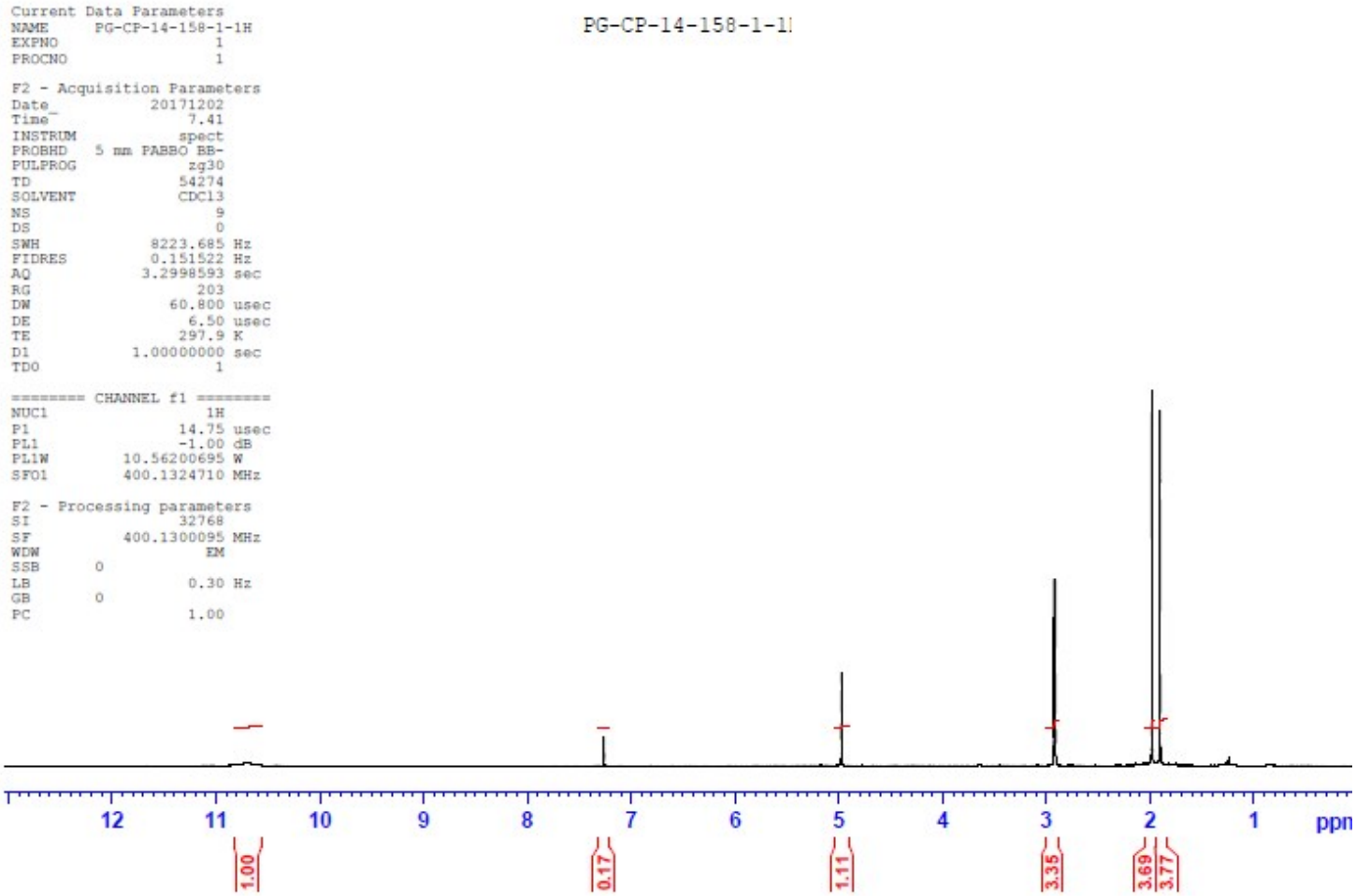


Fig. S20 ^{1}H NMR spectrum of **5** in $CDCl_3$ formed in the reaction of acetyl acetone and methyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

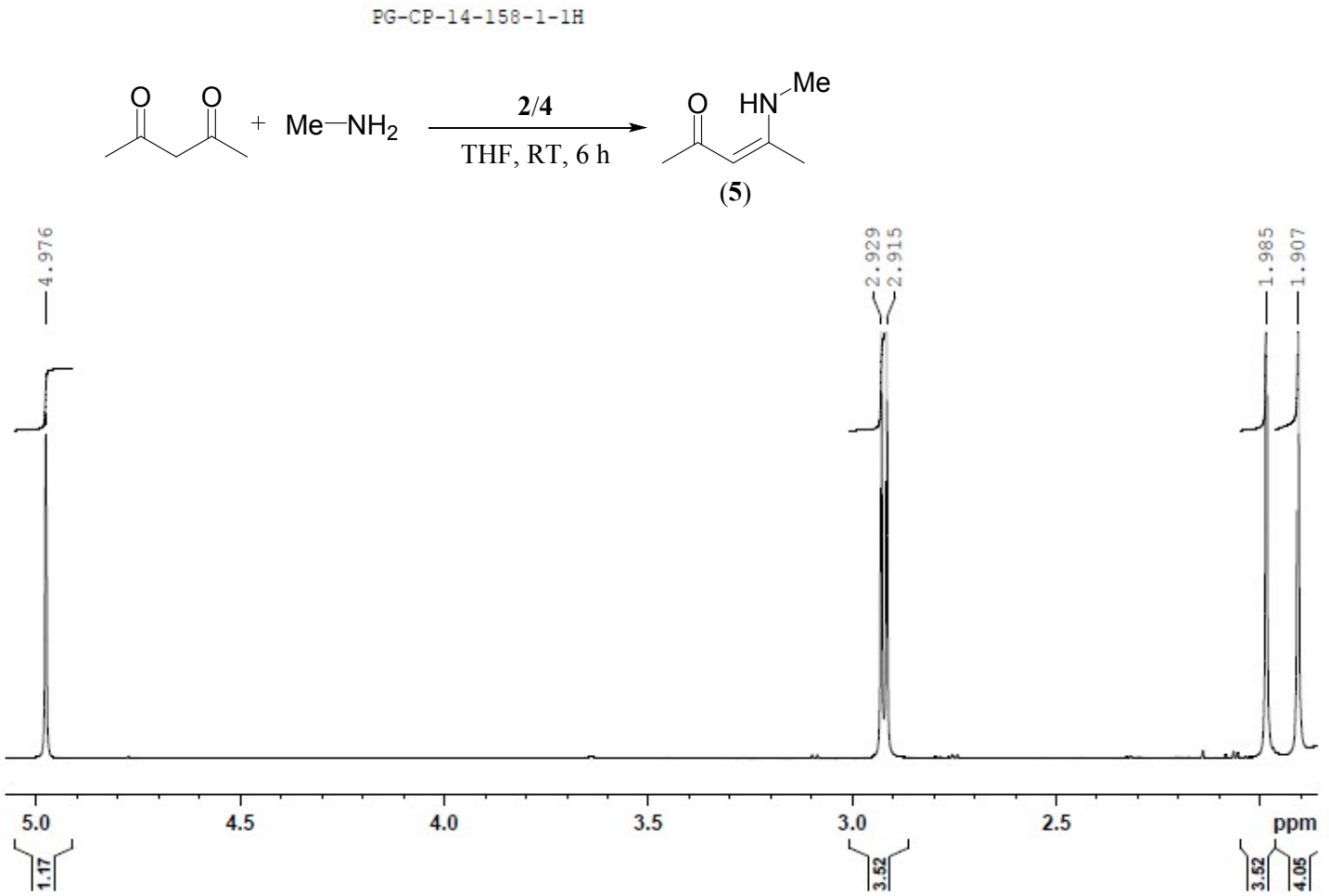


Fig. S21 Expanded ^{1}H NMR spectrum of **5** in $CDCl_3$ formed in the reaction of acetyl acetone and methyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

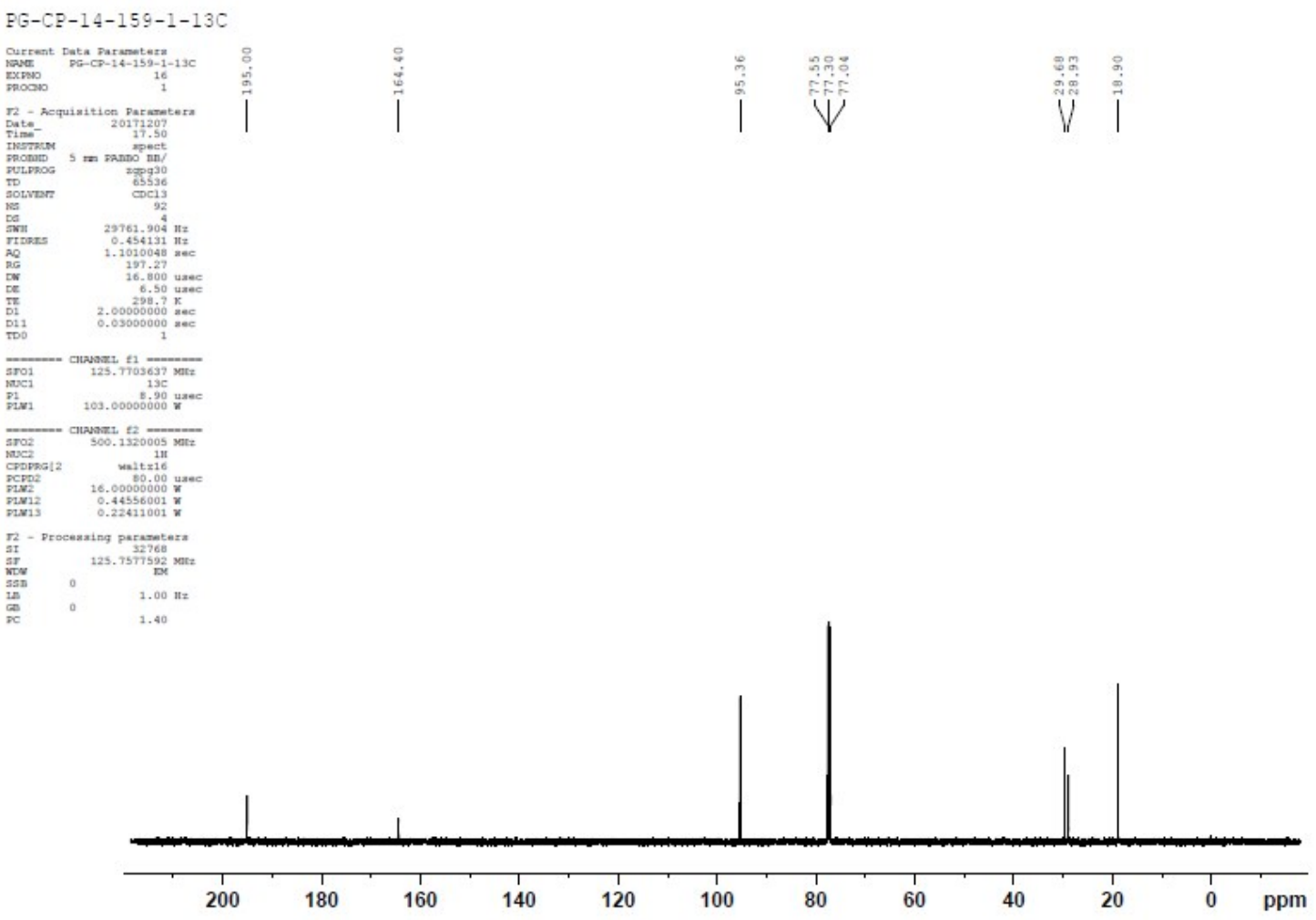


Fig. S22 $^{13}C\{^{1}H\}$ NMR spectrum of **5** in $CDCl_3$ formed in the reaction of acetyl acetone and methyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

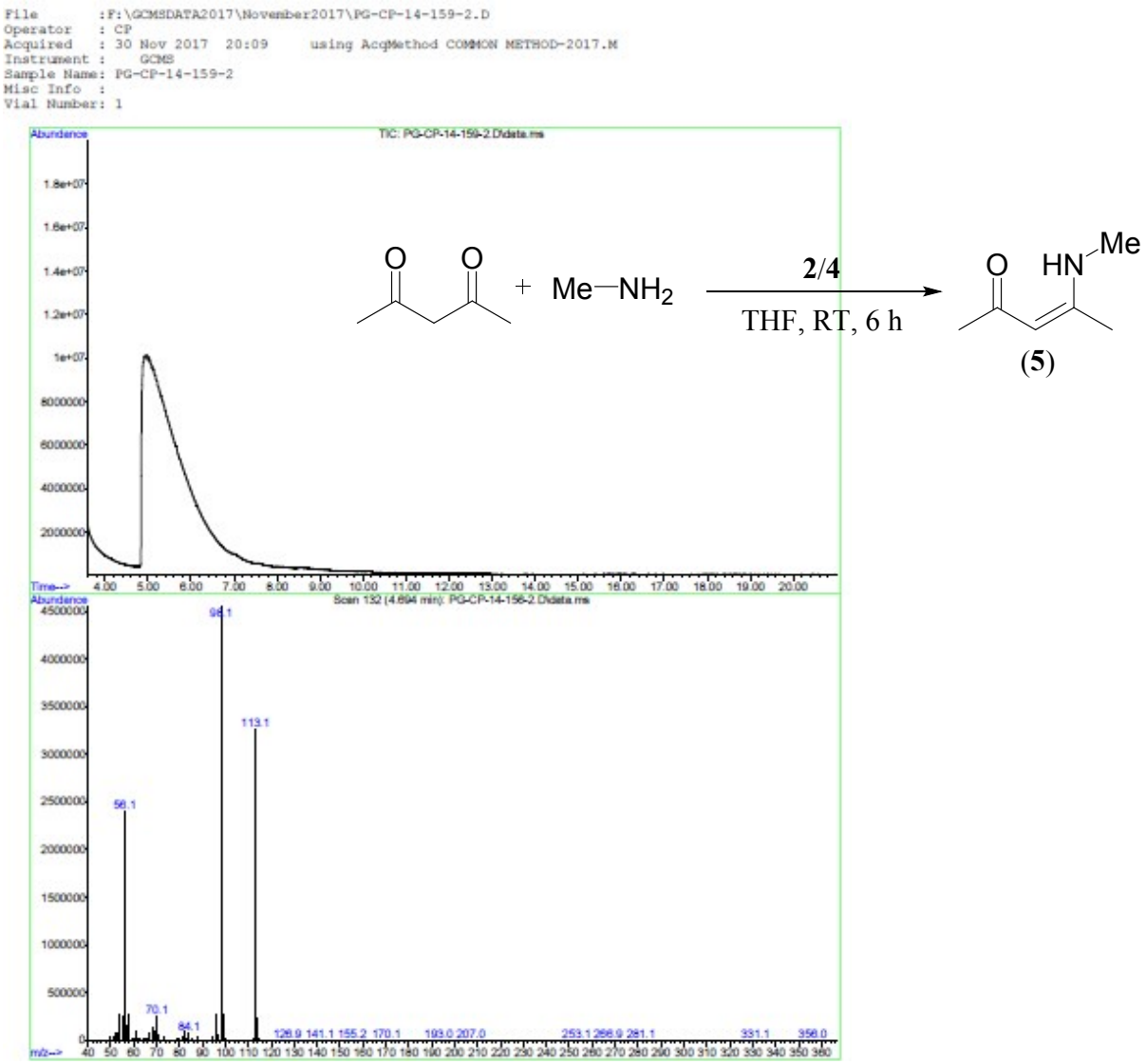
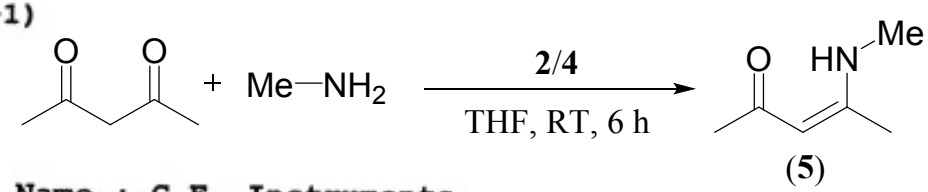


Fig. S23 GCMS trace of **5** (*m/z* 113) in EtOAc formed in the reaction of acetyl acetone and methyl amine as catalyzed by the the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.



Eager 300 Report

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Operator ID : CHANDNI
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Sample ID : PG-CP-14-197-1 (# 6)
Analysis Type : UnkNown (Area)

Company Name : C.E. Instruments
Printed : 12/31/2017 22:02
Instrument N. : Instrument #1
Sample weight : 1.271

Calib. method : using 'K Factors'

!!! Warning missing one or more peaks.

Element Name	%	Ret.Time	Area	BC	Area ratio	K factor
1	0.0000	2	139533	RS		0.0000
Nitrogen	12.3527	41	170136	RS	12.354090	.108364E+07
Carbon	63.6455	63	2101869	RS	1.000000	.259525E+07
Hydrogen	9.1709	190	775439	RS	2.710554	.665260E+07
Totals	85.1691		3186977			

Fig.S24 Elemental analysis data of **5** formed in the reaction of acetyl acetone and methyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

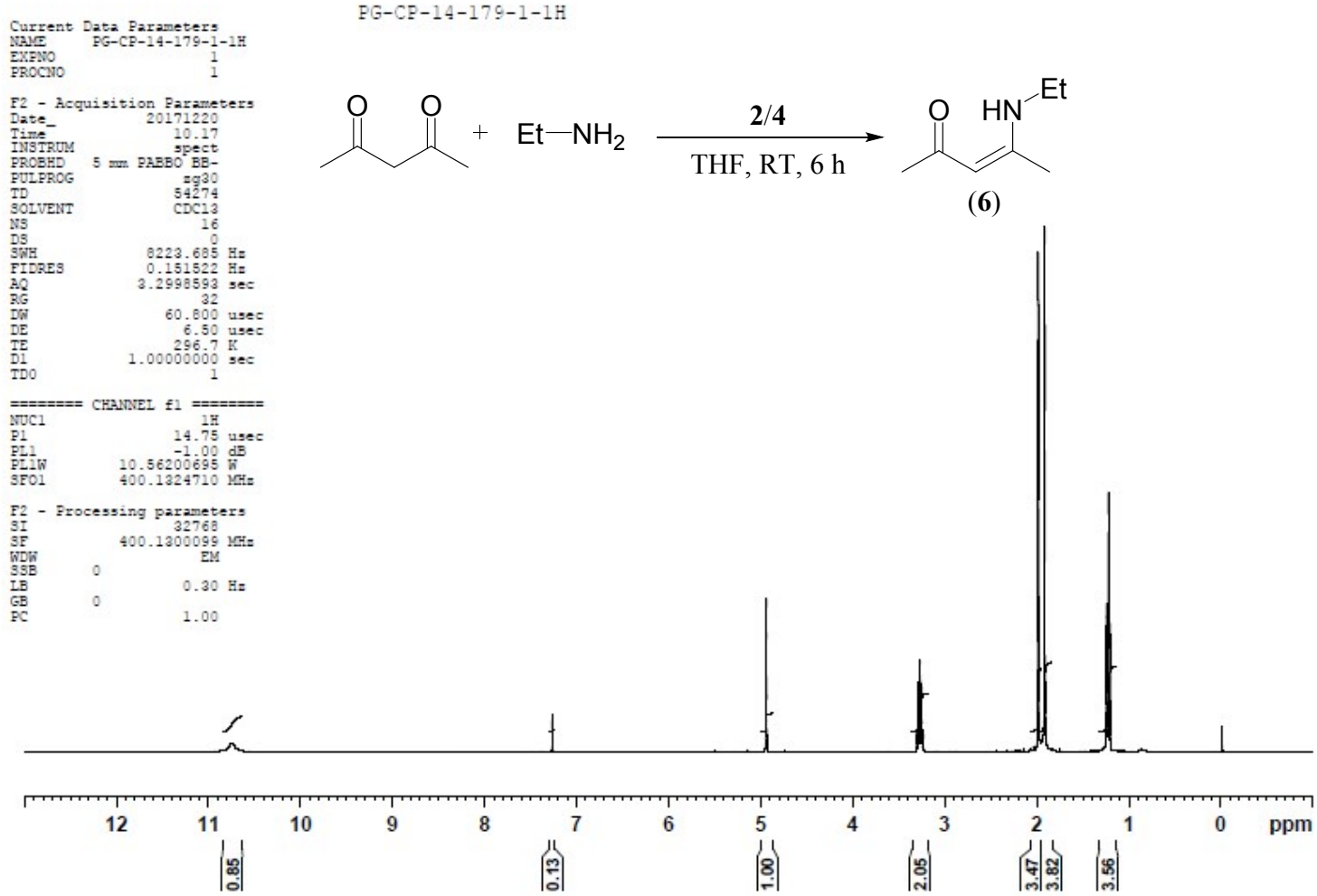


Fig. S25 ^{1}H NMR spectrum of **6** in $CDCl_3$ formed in the reaction of acetyl acetone and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

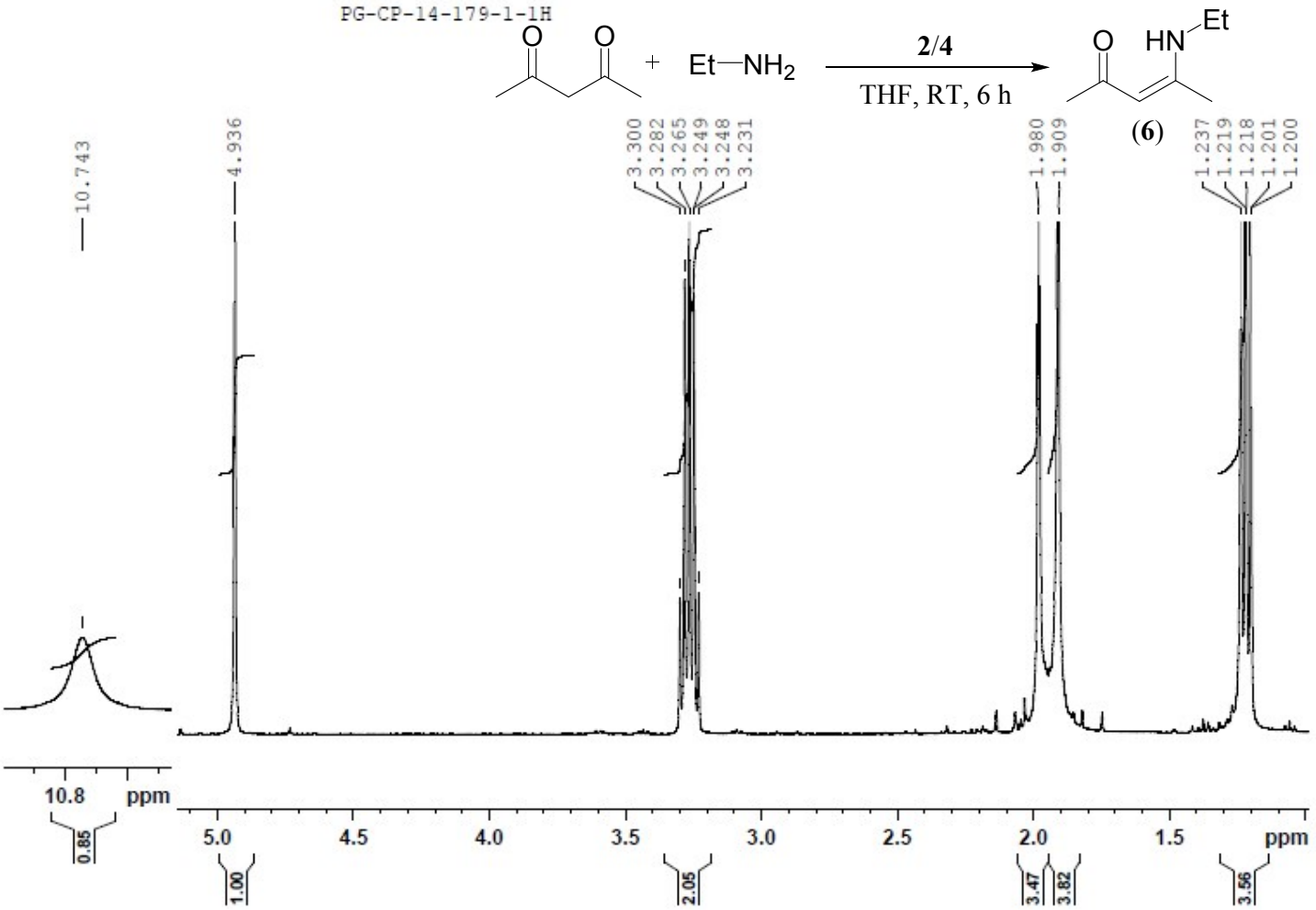


Fig. S26 Expanded ^{1}H NMR spectrum of **6** in $CDCl_3$ formed in the reaction of acetyl acetone and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

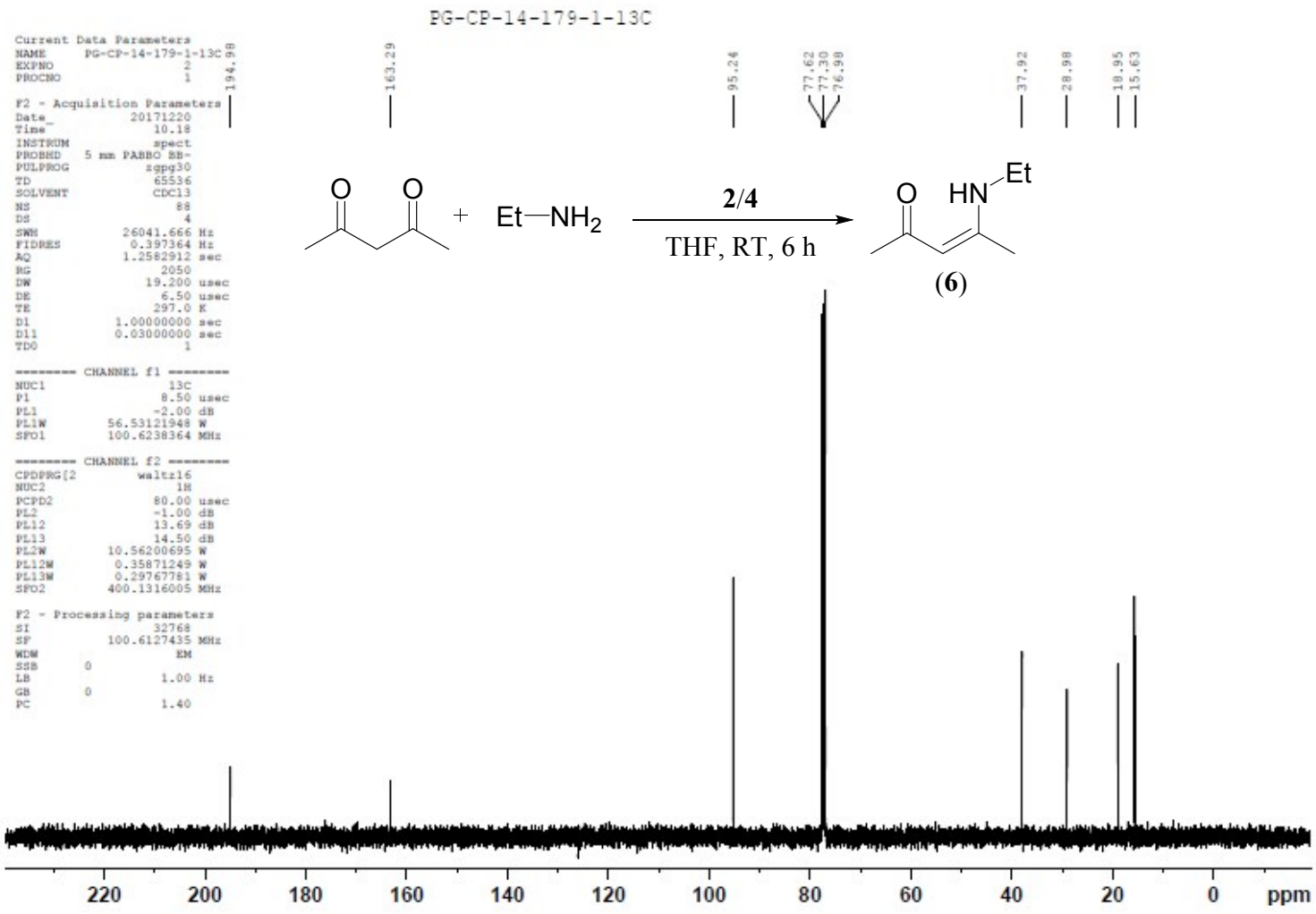


Fig. S27 $^{13}C\{^{1}H\}$ NMR spectrum of **6** in $CDCl_3$ formed in the reaction of acetyl acetone and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

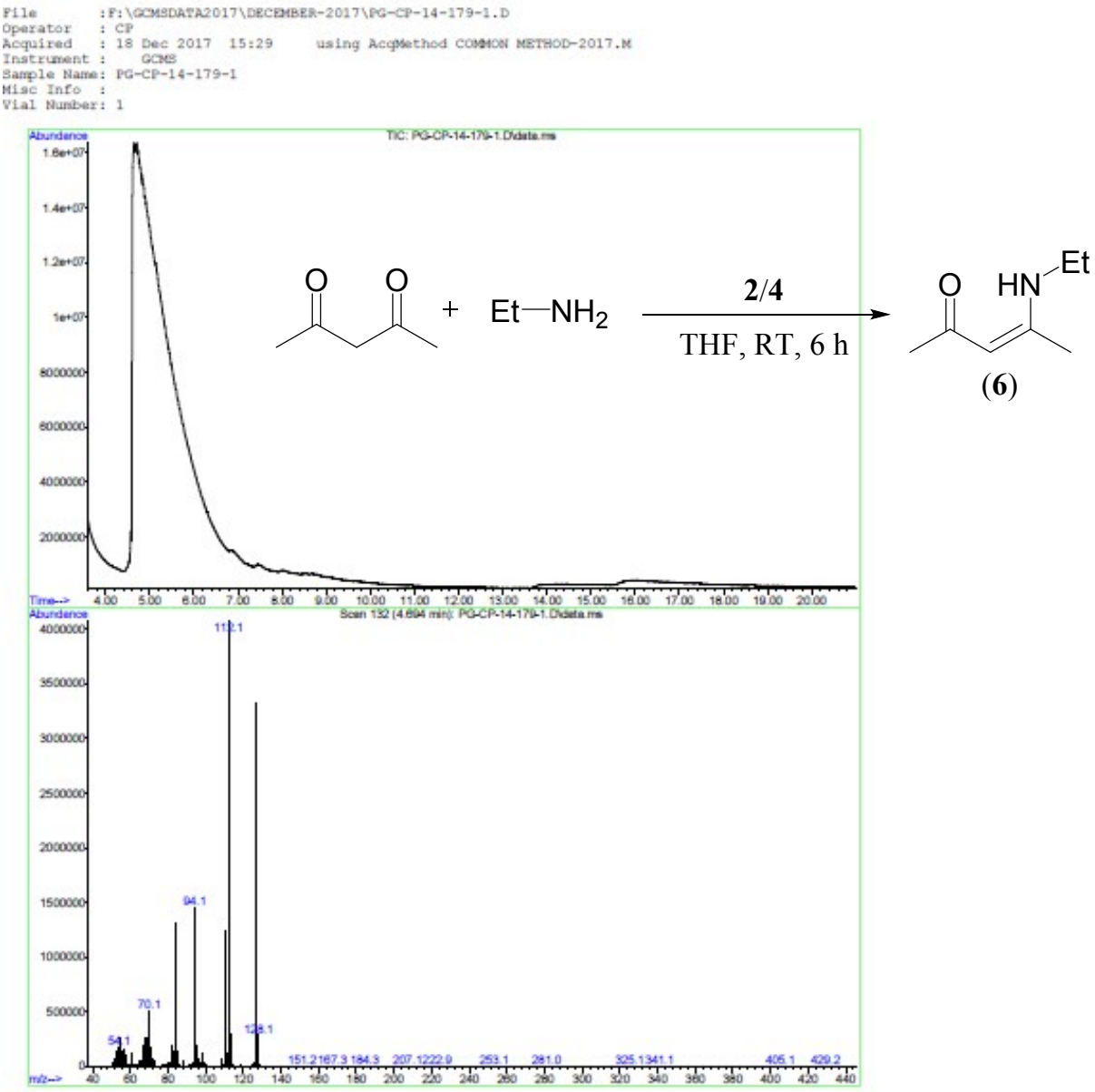


Fig. S28 GCMS trace of **6** (*m/z* 127) in EtOAc formed in the reaction of acetyl acetone and ethyl amine as catalyzed by the the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

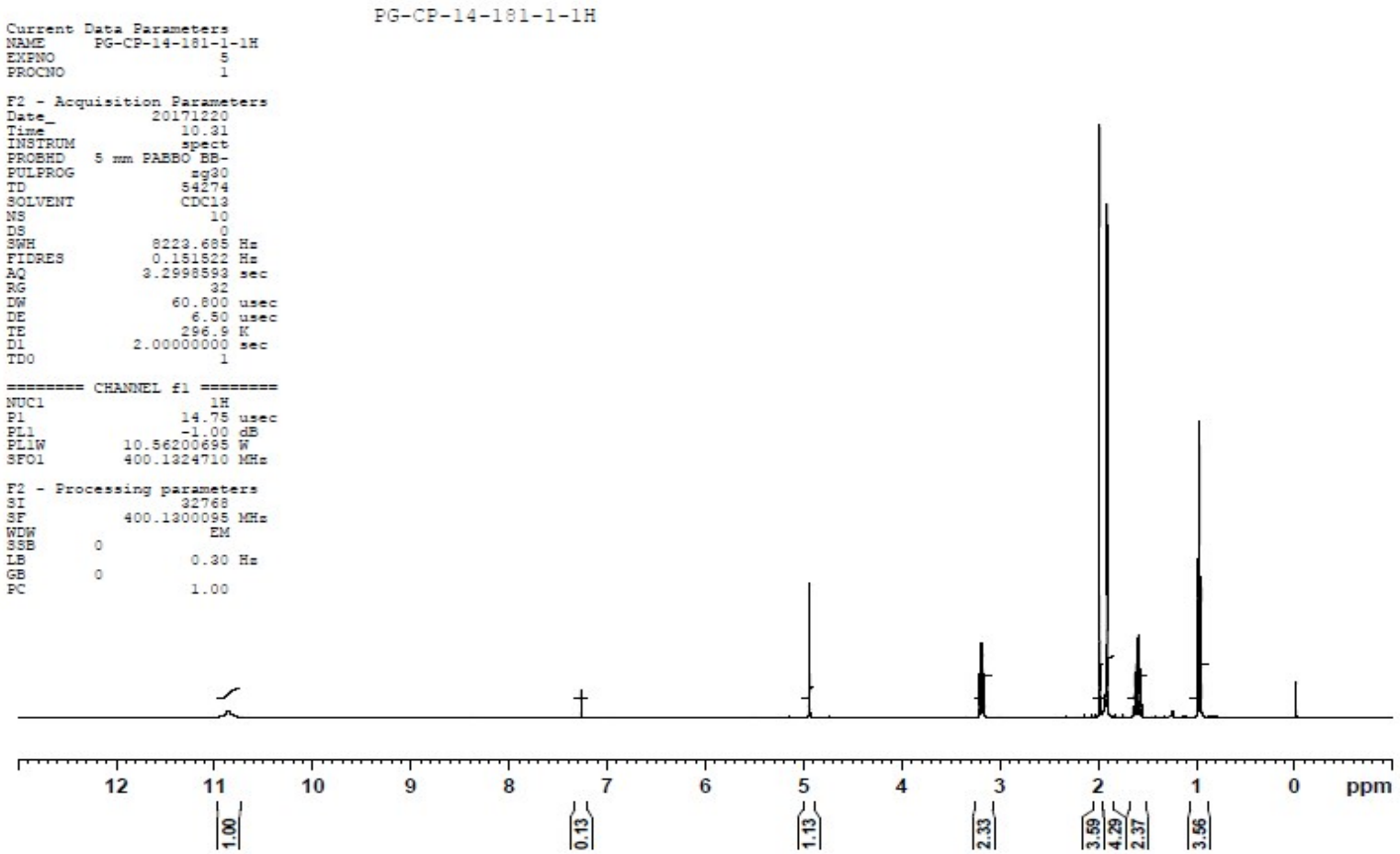


Fig. S29 ^{1}H NMR spectrum of **7** in $CDCl_3$ formed in the reaction of acetyl acetone and *n*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (2) and $[CoL^2]_2$ (4) complexes.

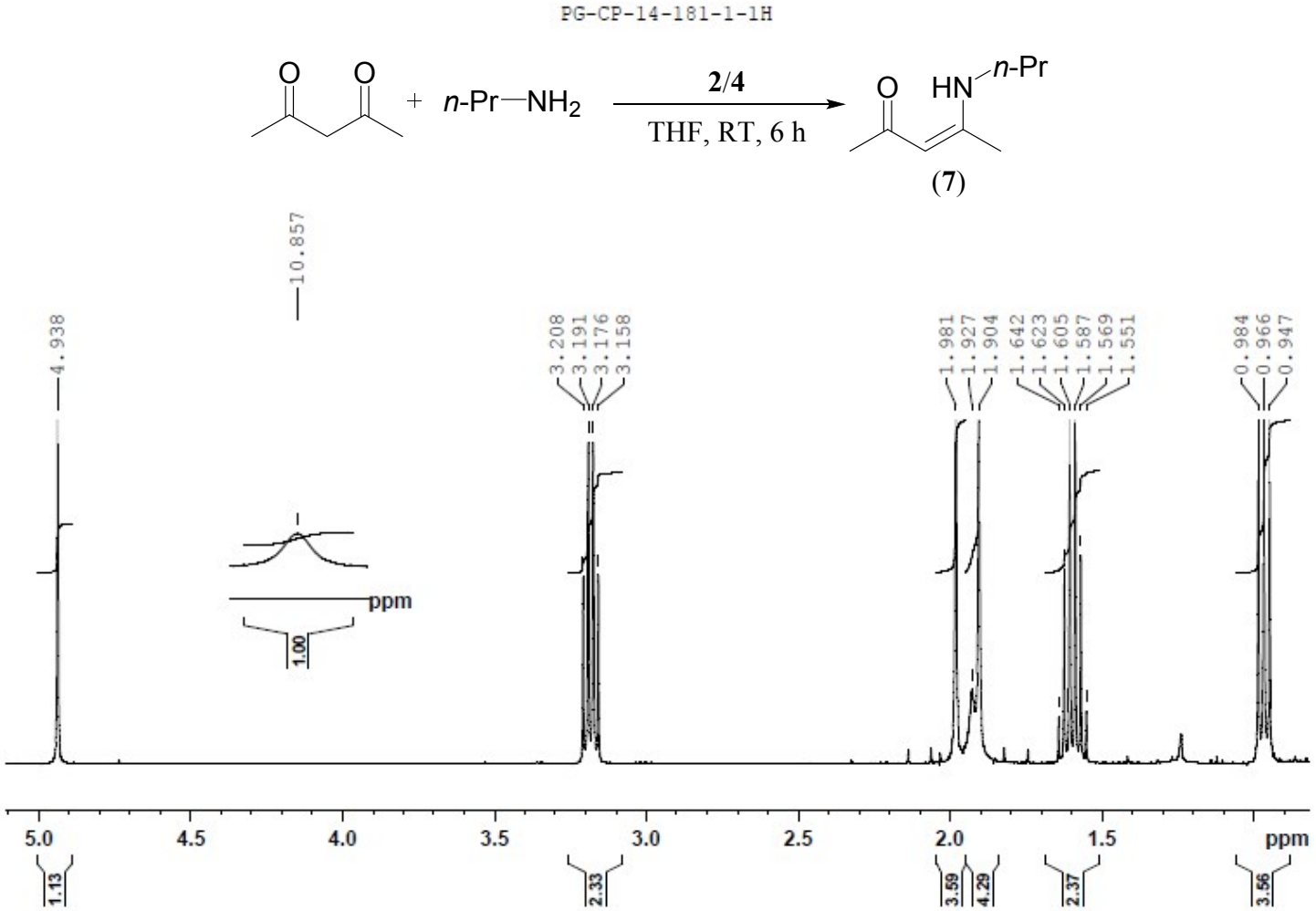


Fig. S30 Expanded ^{1}H NMR spectrum of 7 in $CDCl_3$ formed in the reaction of acetyl acetone and *n*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (2) and $[CoL^2]_2$ (4) complexes.

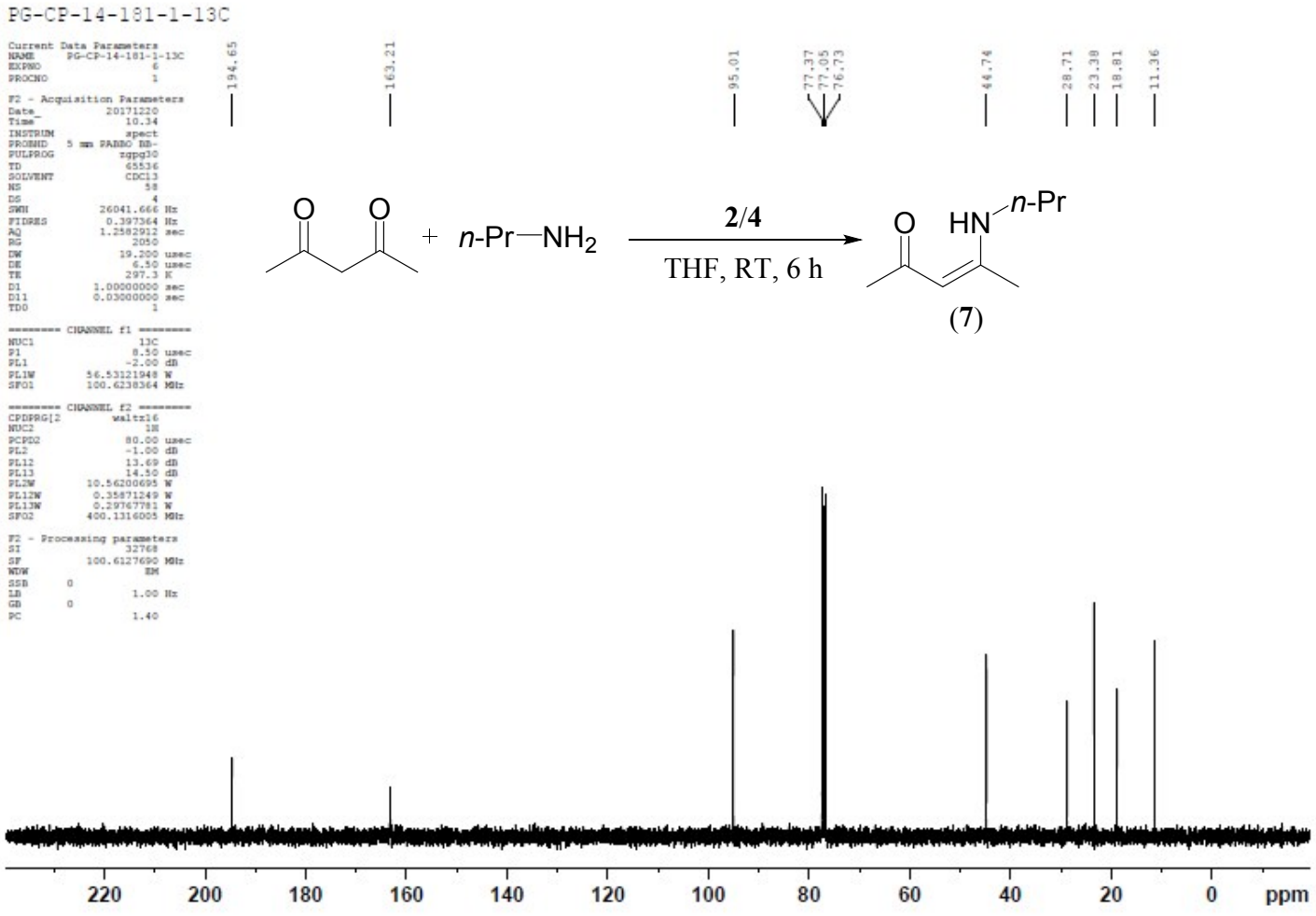


Fig.S31 $^{13}C\{^{1}H\}$ NMR spectrum of 7 in $CDCl_3$ formed in the reaction of acetyl acetone and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

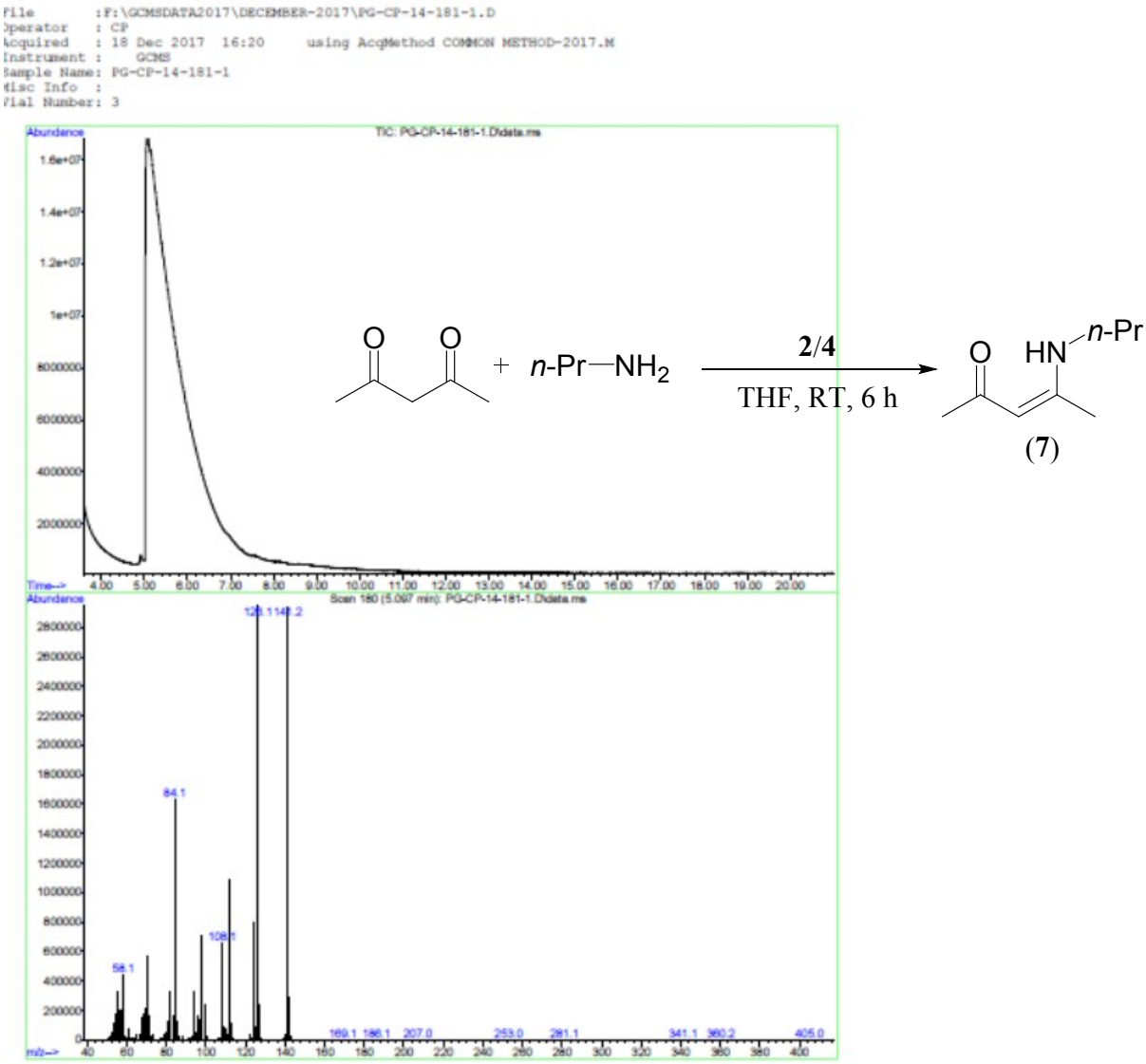


Fig. S32 GCMS trace of 7 (*m/z* 141) in EtOAc formed in the reaction of acetyl acetone and *n*-propyl amine as catalyzed by the the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

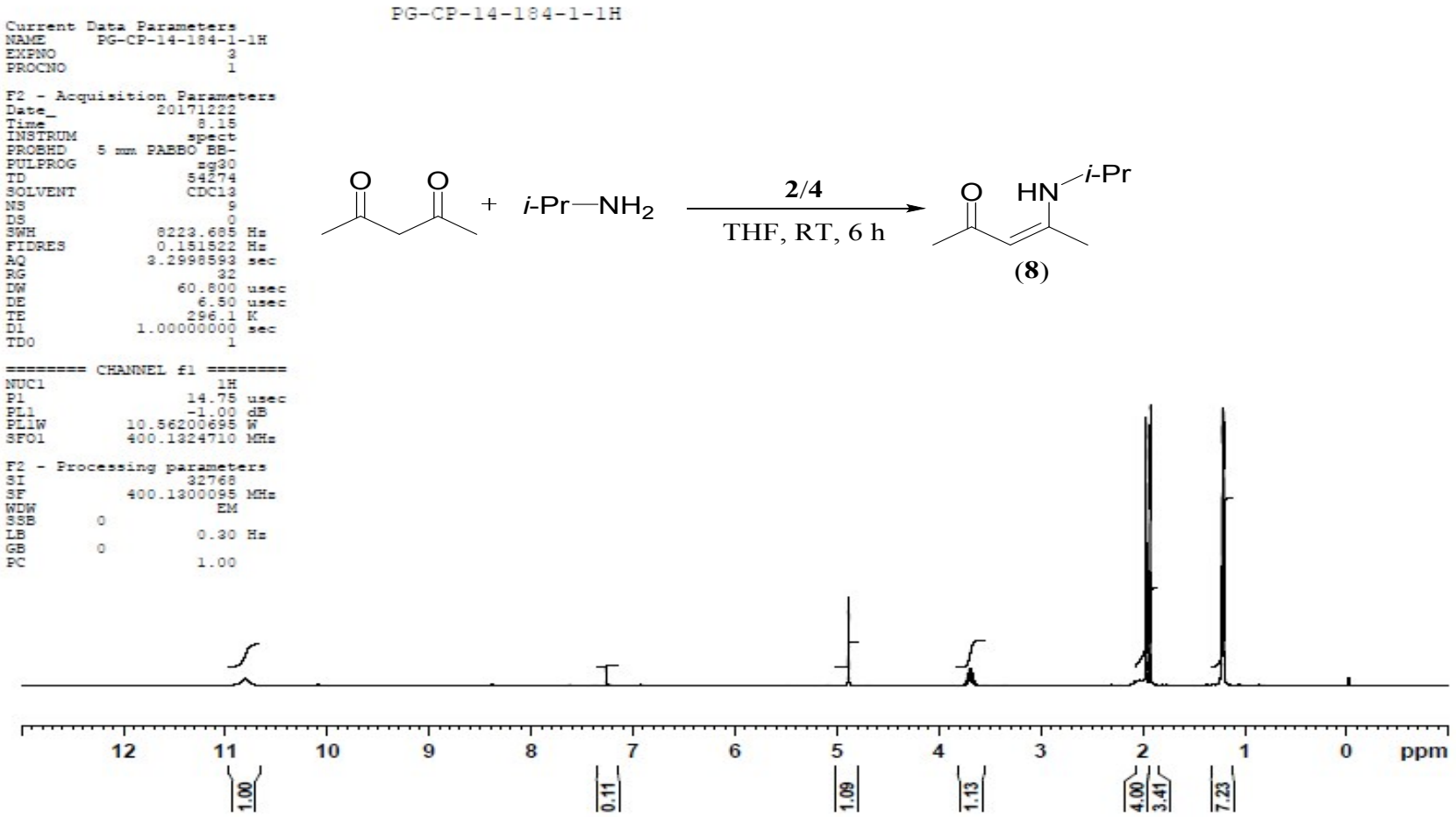


Fig.S33 ^{1}H NMR spectrum of **8** in $CDCl_3$ formed in the reaction of acetyl acetone and *i*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

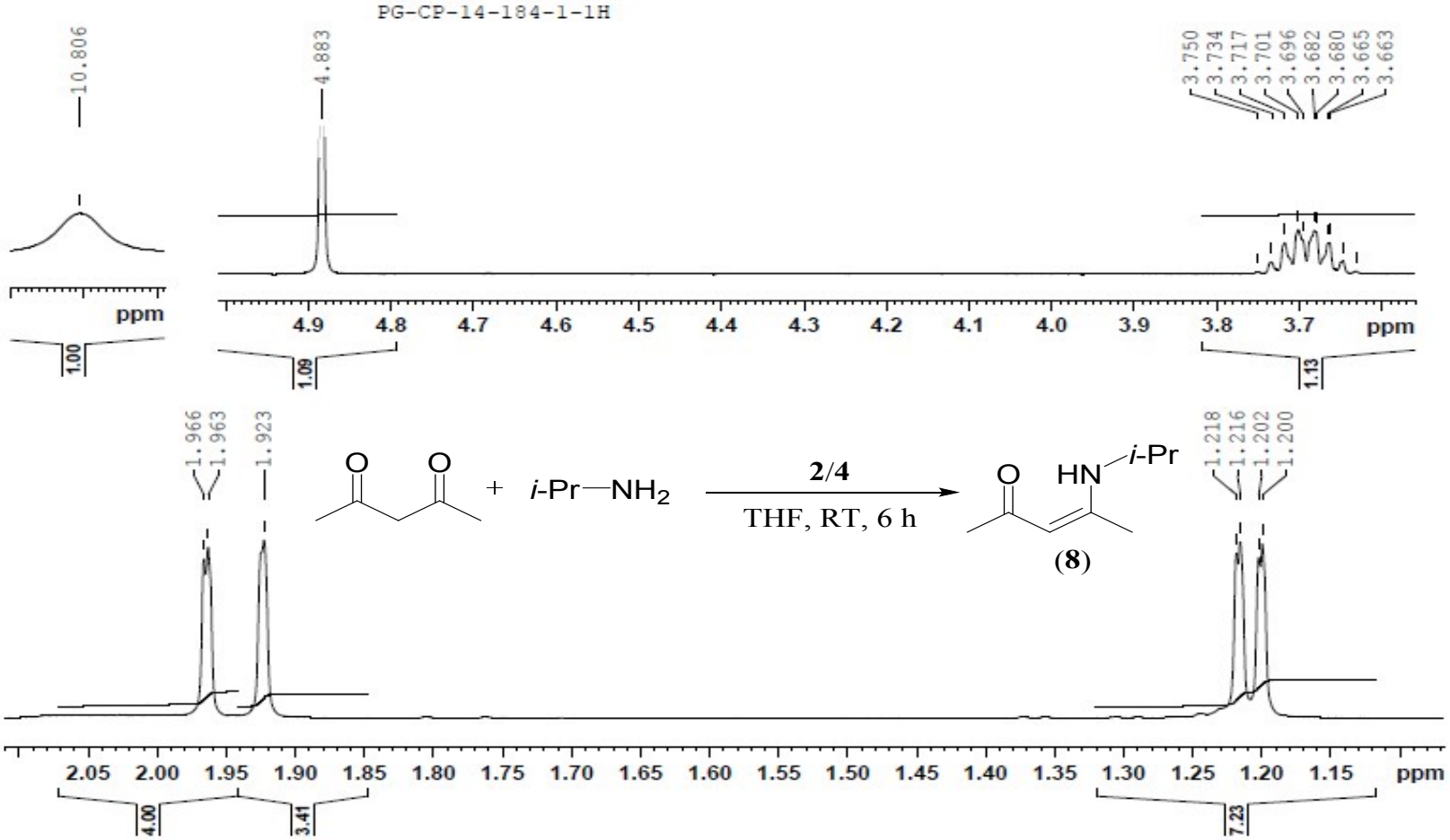


Fig. S34 Expanded ^{1}H NMR spectrum of **8** in $CDCl_3$ formed in the reaction of acetyl acetone and *i*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

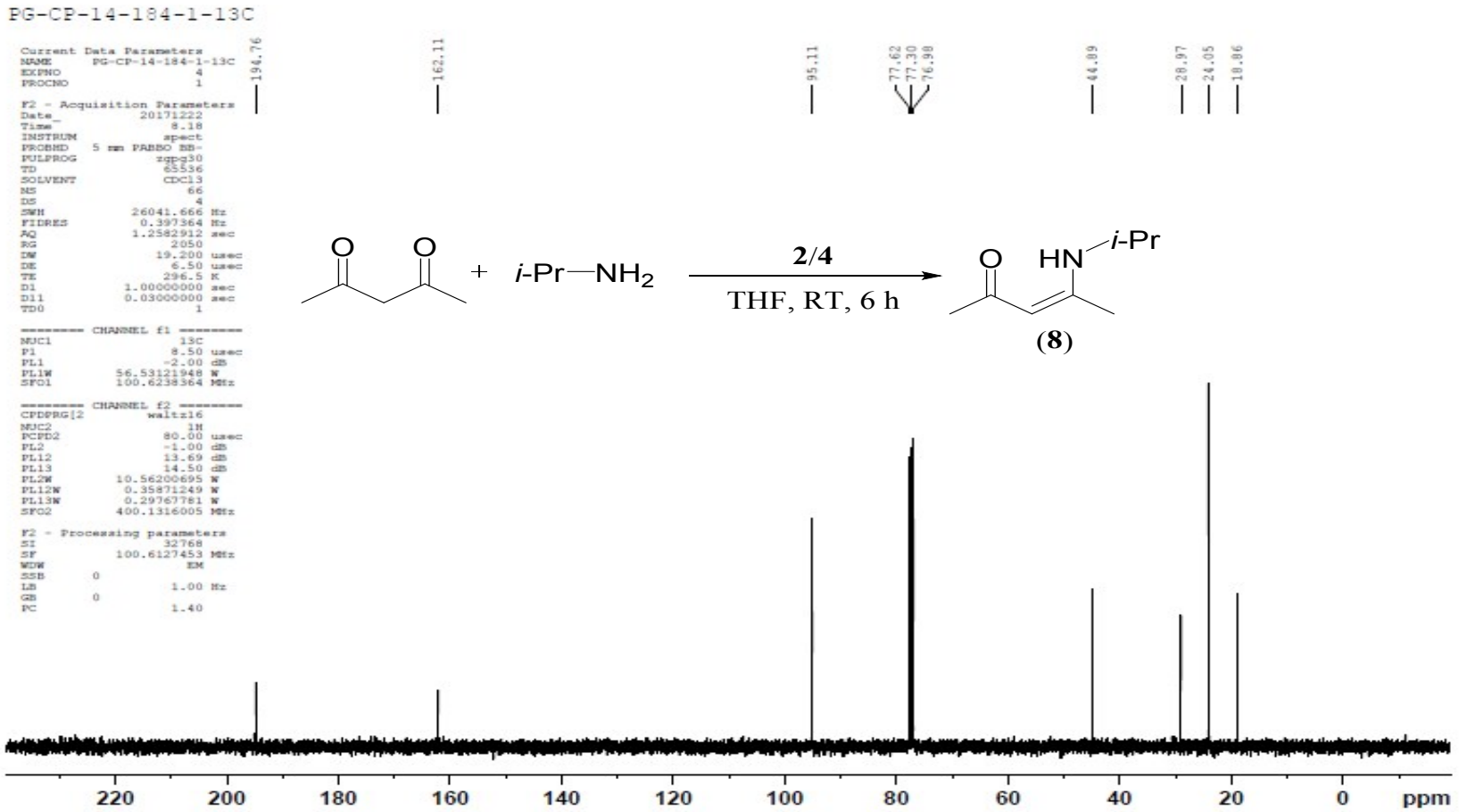


Fig. S35 13C{1H} NMR spectrum of **8** in CDCl3 formed in the reaction of acetyl acetone and ethyl amine as catalyzed by the dinuclear [CoL1]2 (**2**) and [CoL2]2 (**4**) complexes.

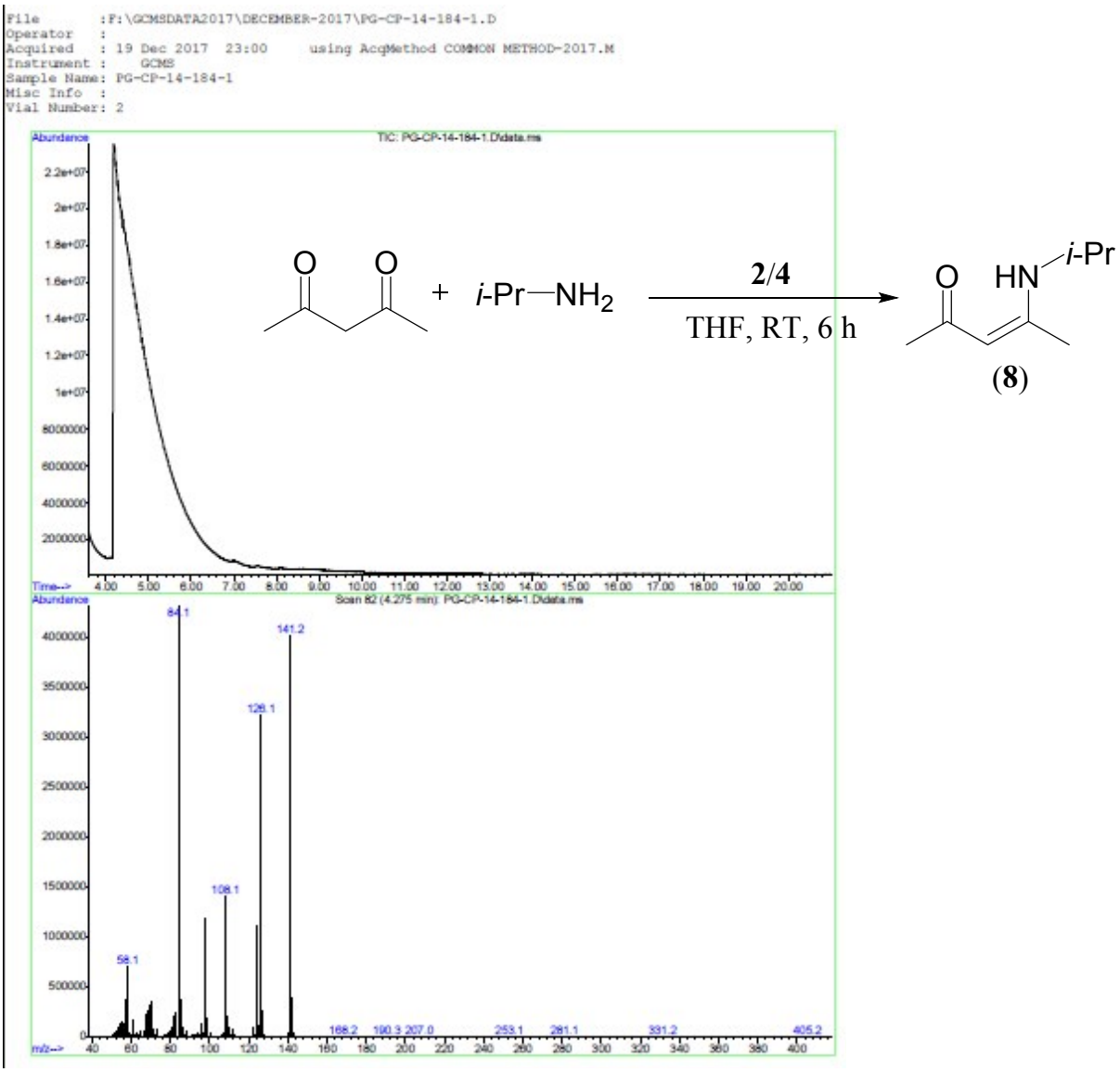


Fig. S36 GCMS trace of **8** (*m/z* 141) in EtOAc formed in the reaction of acetyl acetone and *i*-propyl amine as catalyzed by the the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

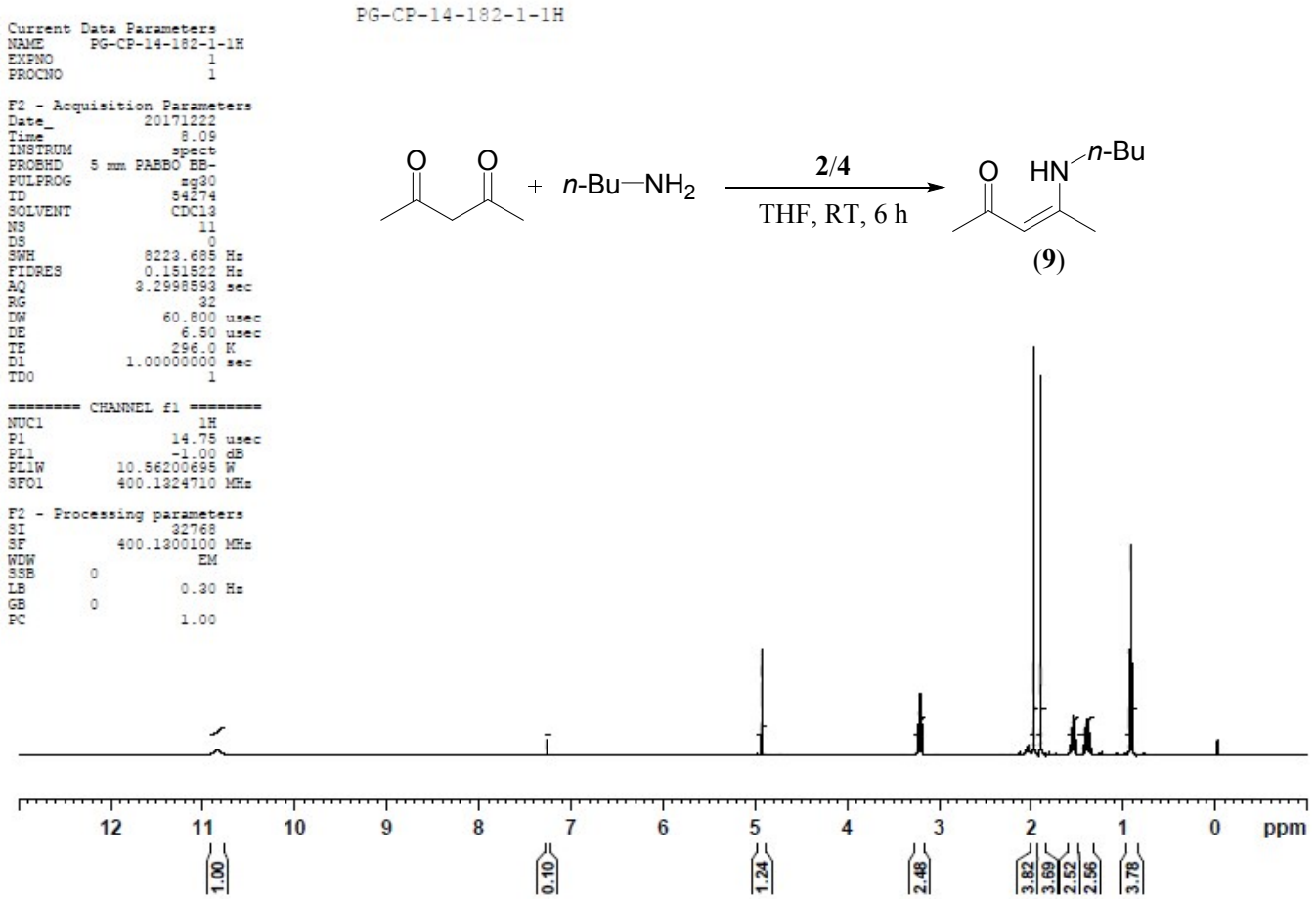


Fig. S37 ^{1}H NMR spectrum of **9** in $CDCl_3$ formed in the reaction of acetyl acetone and *n*-butyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

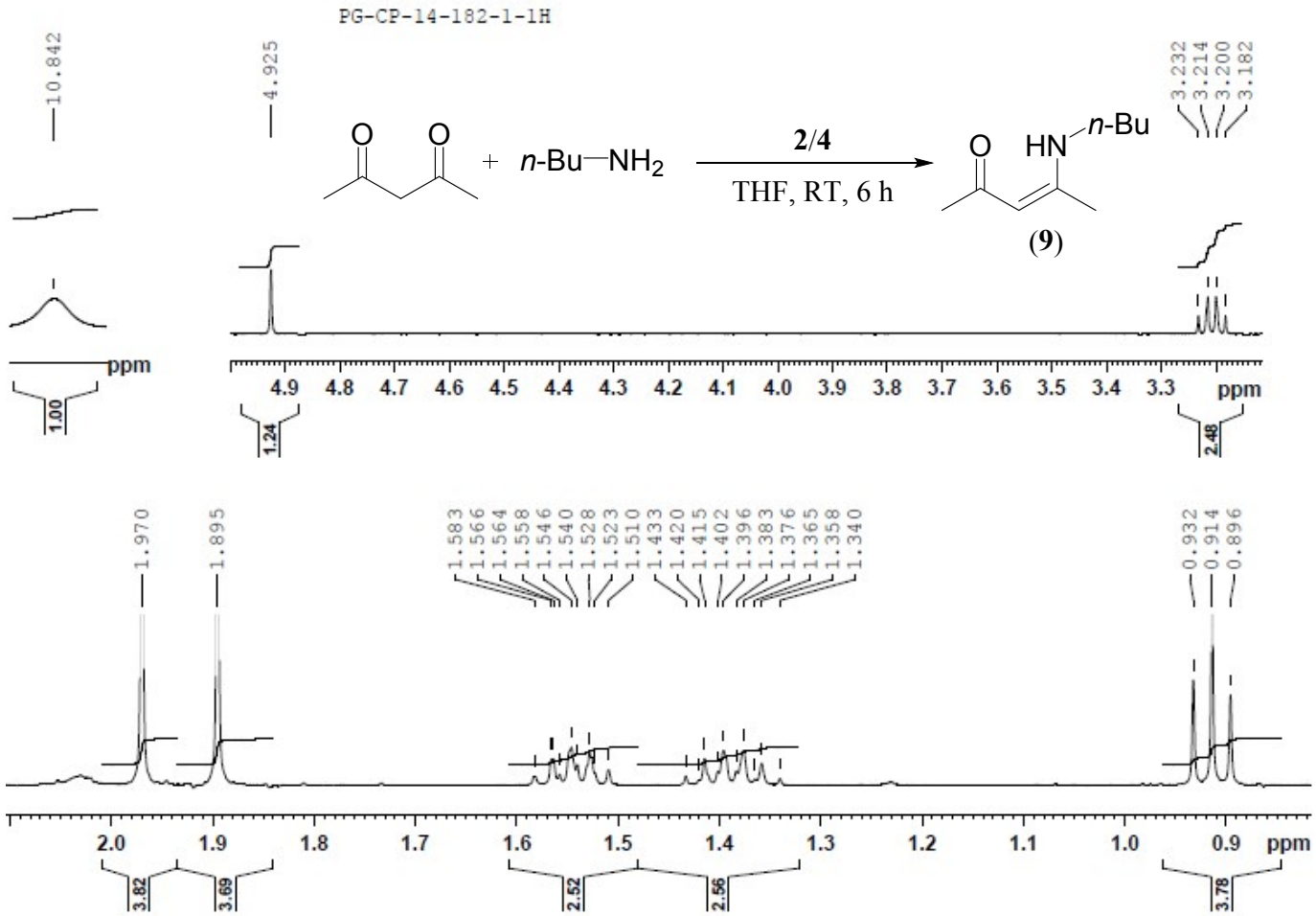


Fig. S38 Expanded 1H NMR spectrum of **9** in CDCl3 formed in the reaction of acetyl acetone and n-butyl amine as catalyzed by the dinuclear [CoL1]2 (**2**) and [CoL2]2 (**4**) complexes.

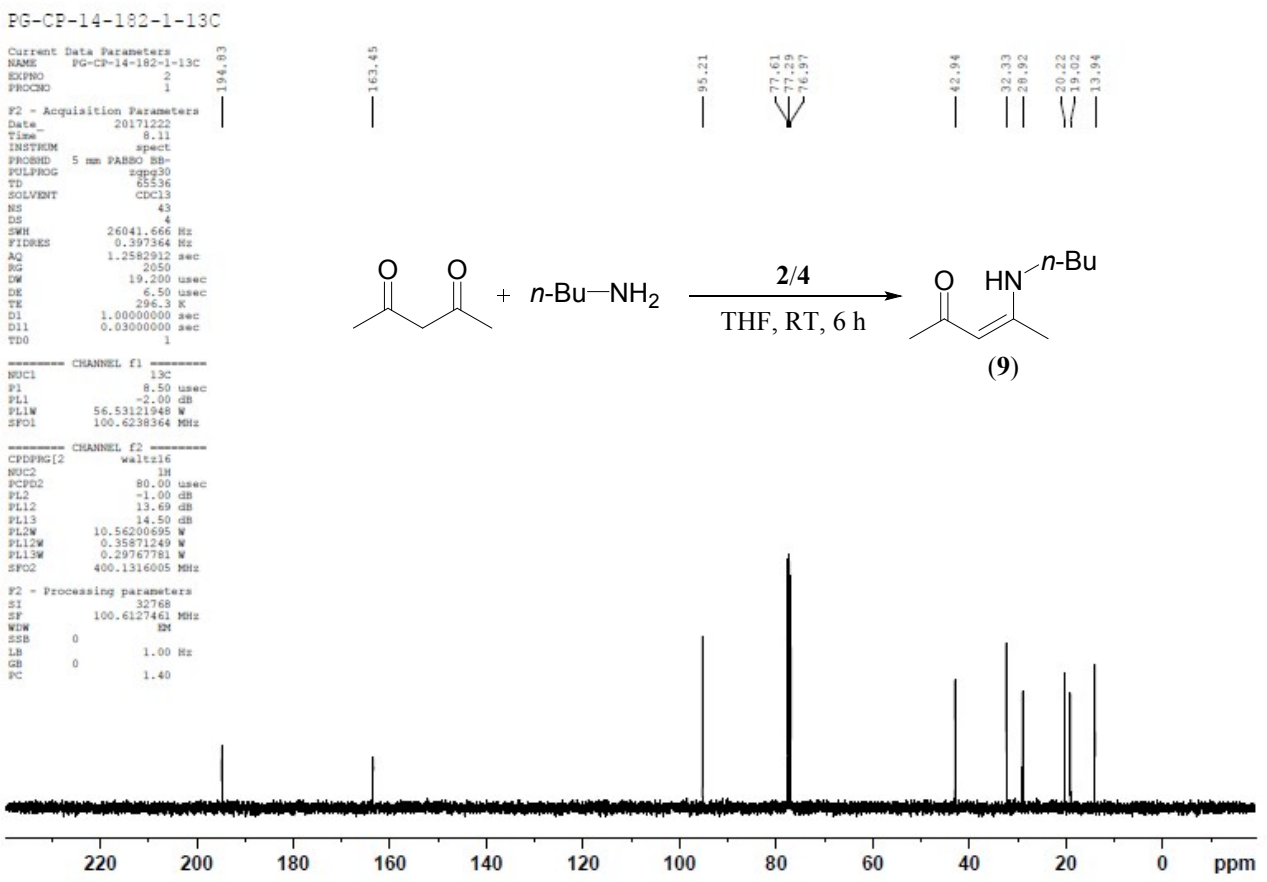


Fig. S39 $^{13}C\{^{1}H\}$ NMR spectrum of **8** in $CDCl_3$ formed in the reaction of acetyl acetone and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

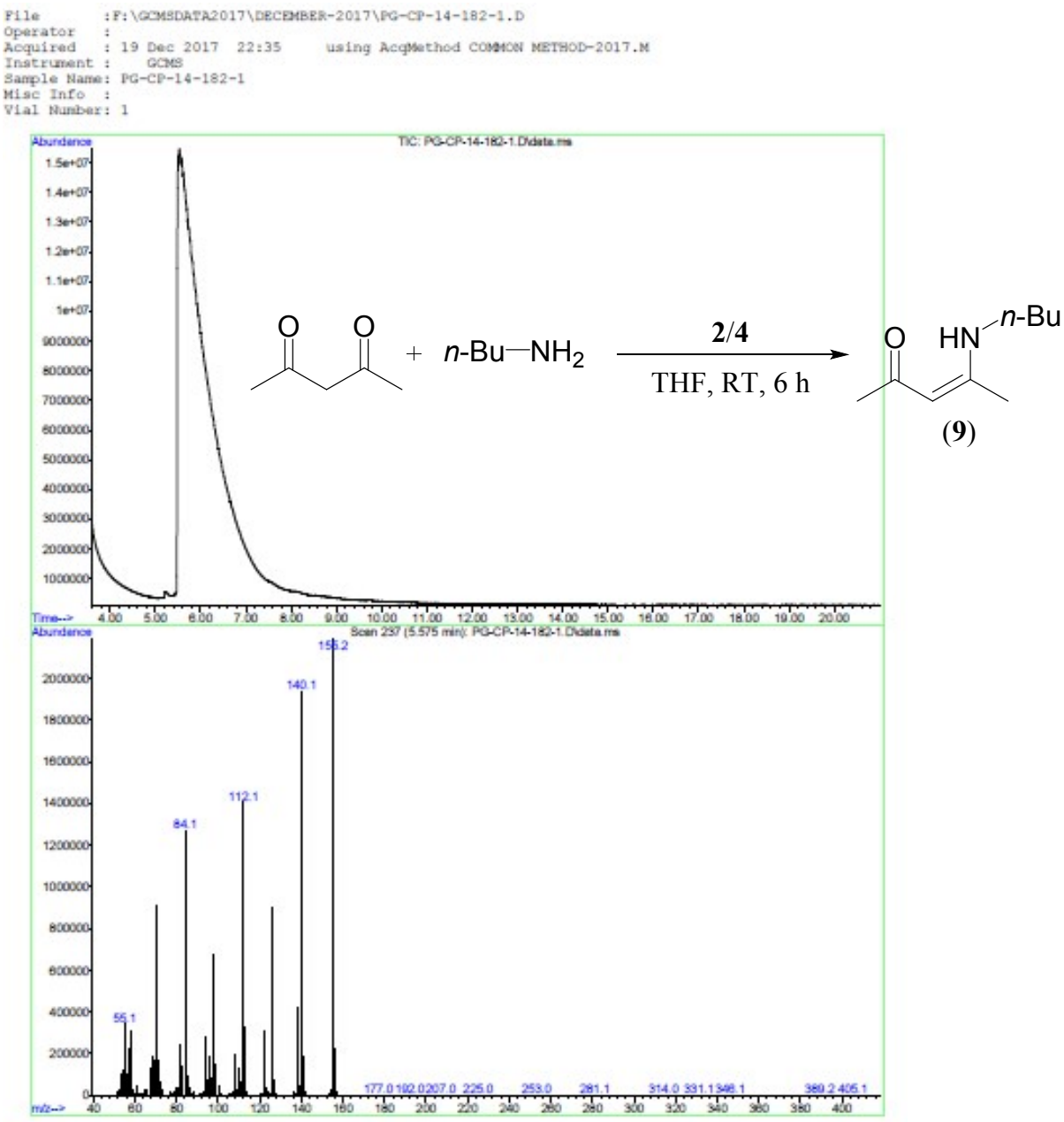


Fig. S40 GCMS trace of **9** (*m/z* 155) in EtOAc formed in the reaction of acetyl acetone and *n*-butyl amine as catalyzed by the the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

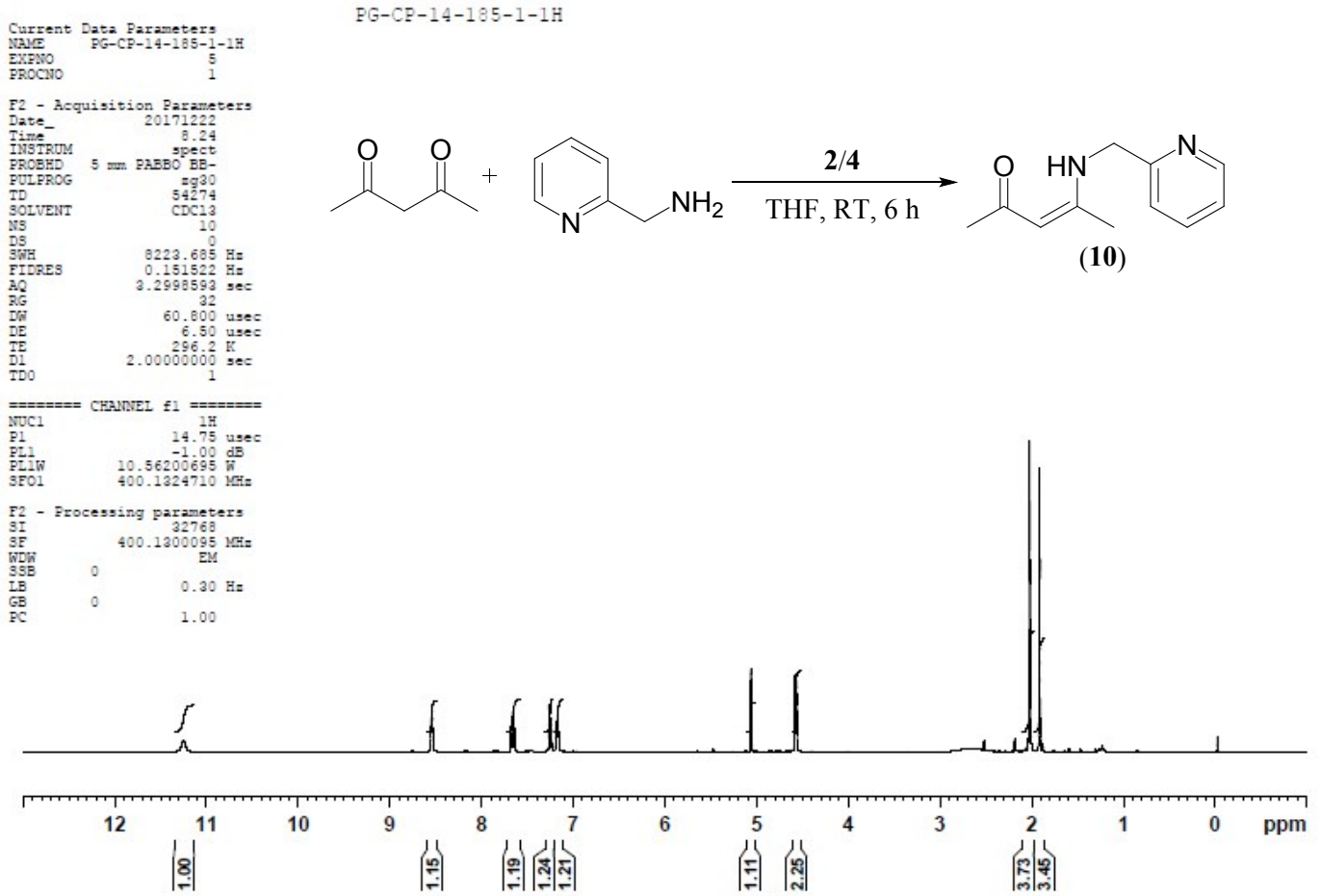


Fig. S41 ^{1}H NMR spectrum of **10** in $CDCl_3$ formed in the reaction of acetyl acetone and 2-picolyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

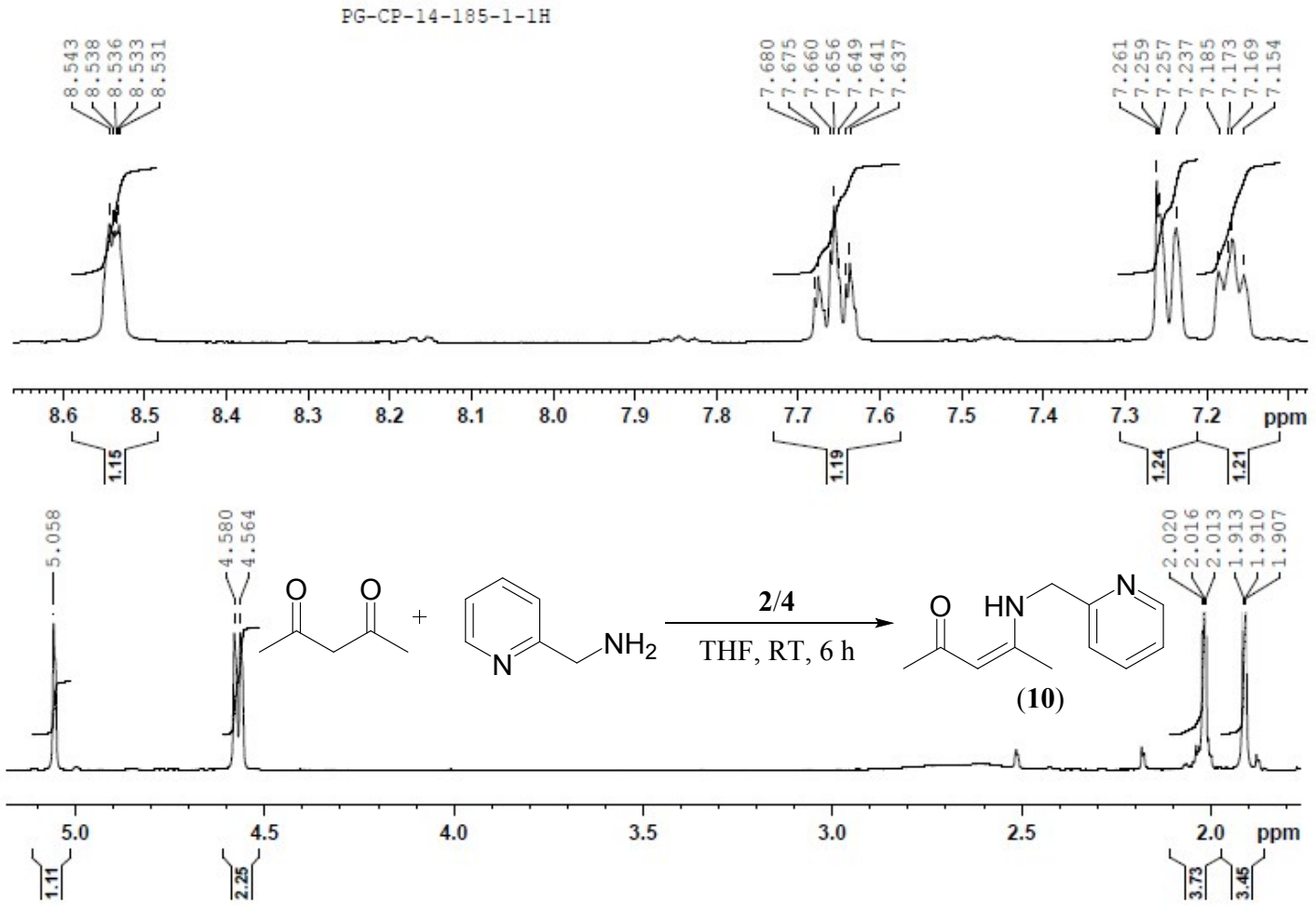


Fig. S42 Expanded ^{1}H NMR spectrum of **10** in $CDCl_3$ formed in the reaction of acetyl acetone and 2-picolyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

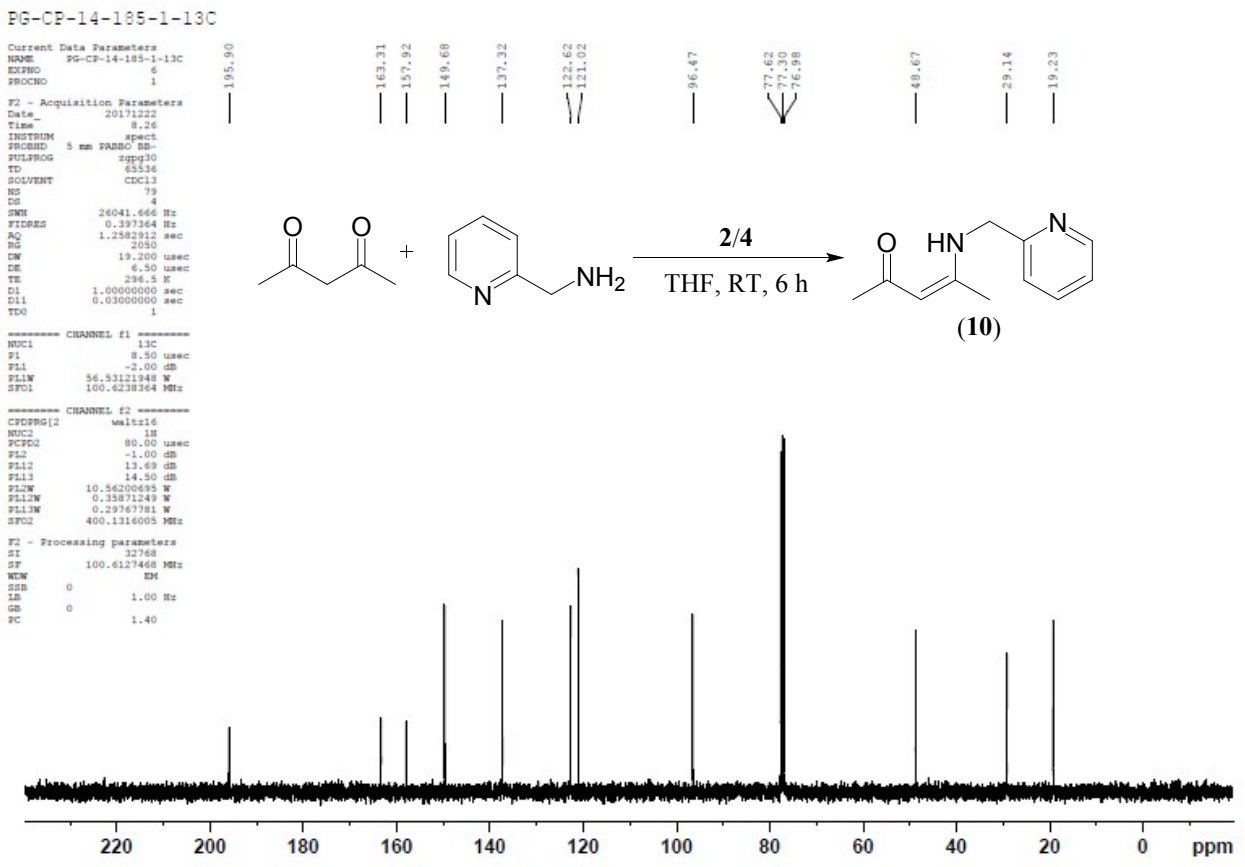


Fig. S43 $^{13}C\{^{1}H\}$ NMR spectrum of **10** in $CDCl_3$ formed in the reaction of acetyl acetone and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

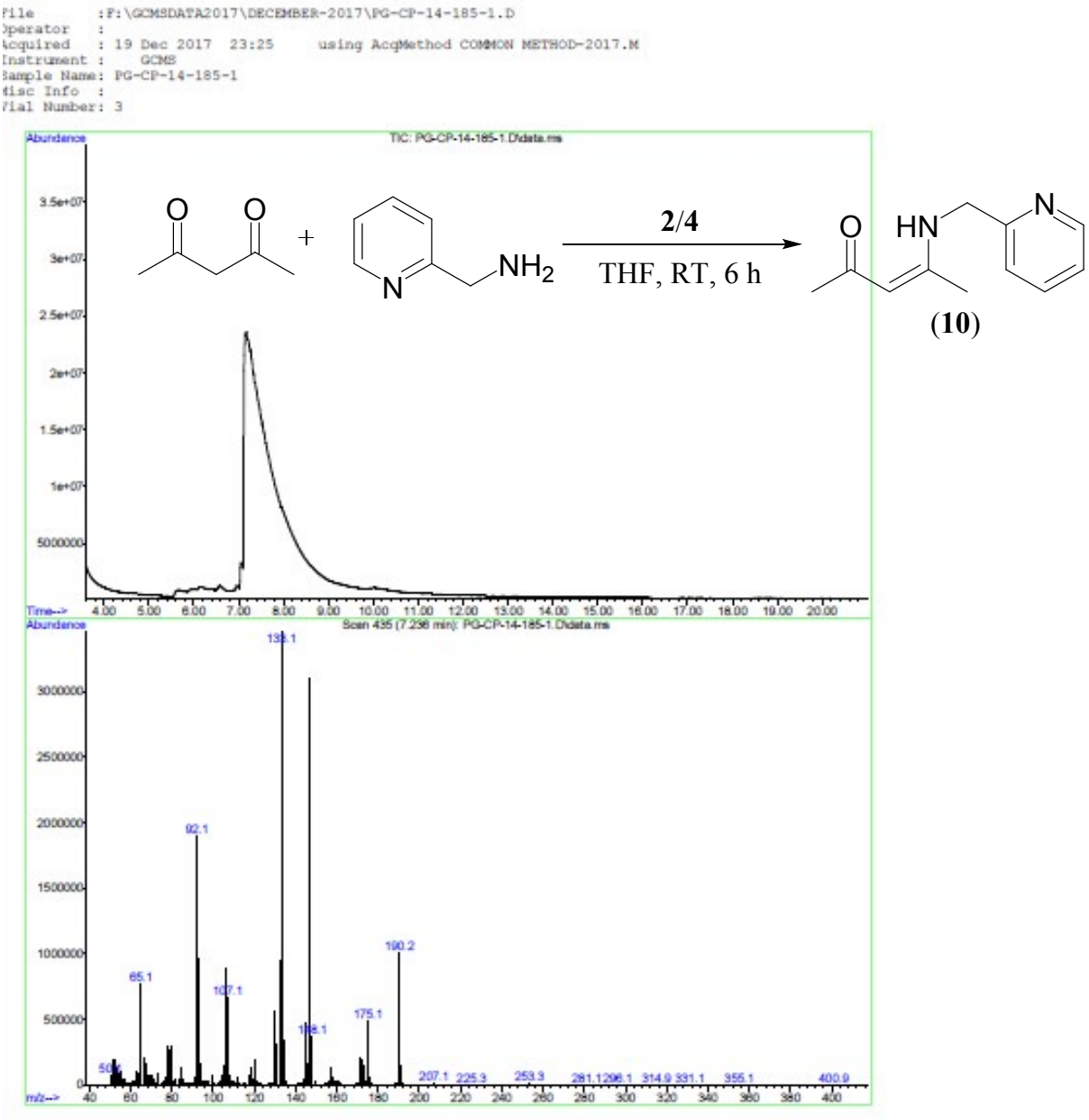


Fig.S44 GCMS trace of **10** (*m/z* 190) in EtOAc formed in the reaction of acetyl acetone and 2-picolyl amine as catalyzed by the the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

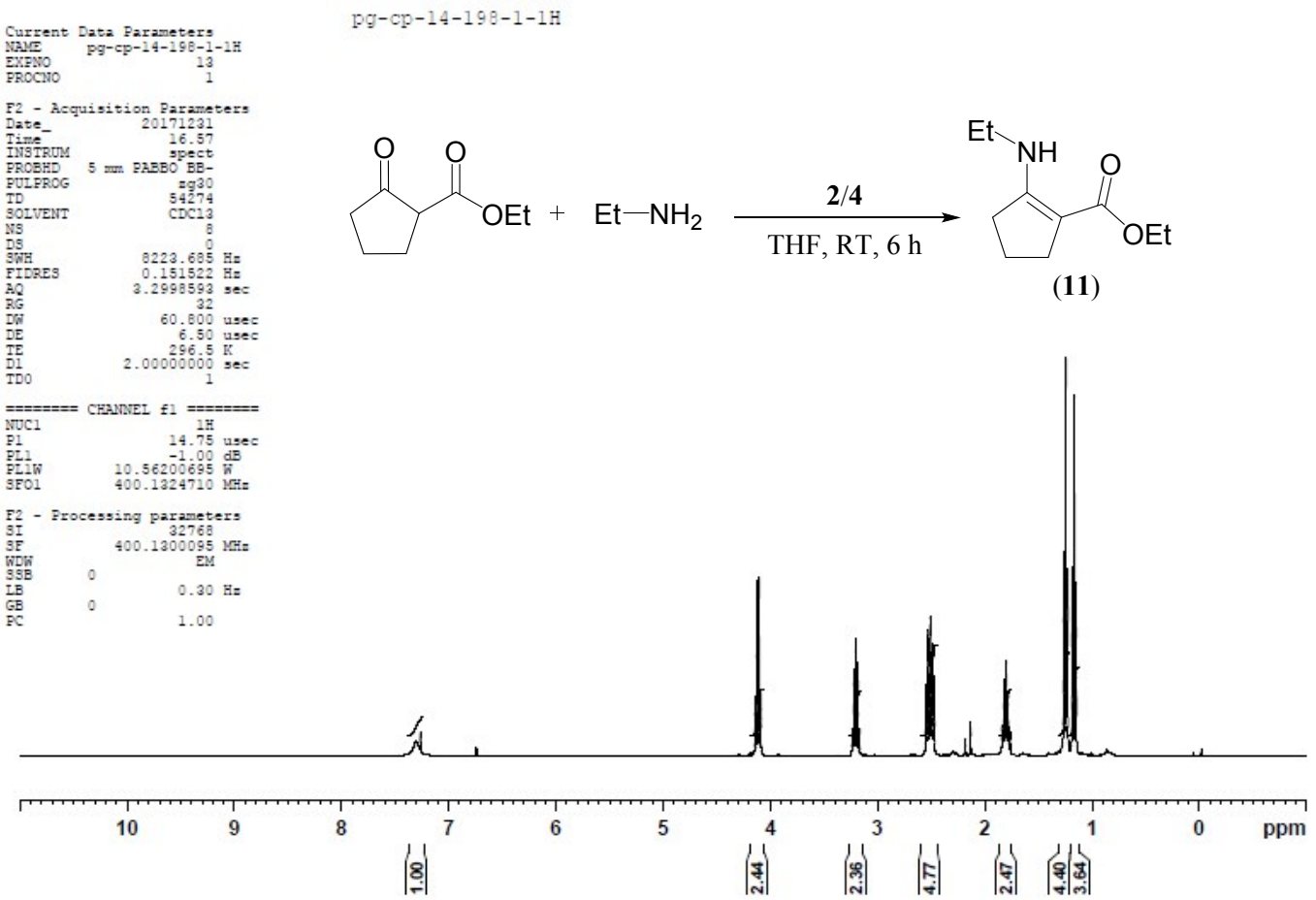


Fig. S45 ^{1}H NMR spectrum of **11** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

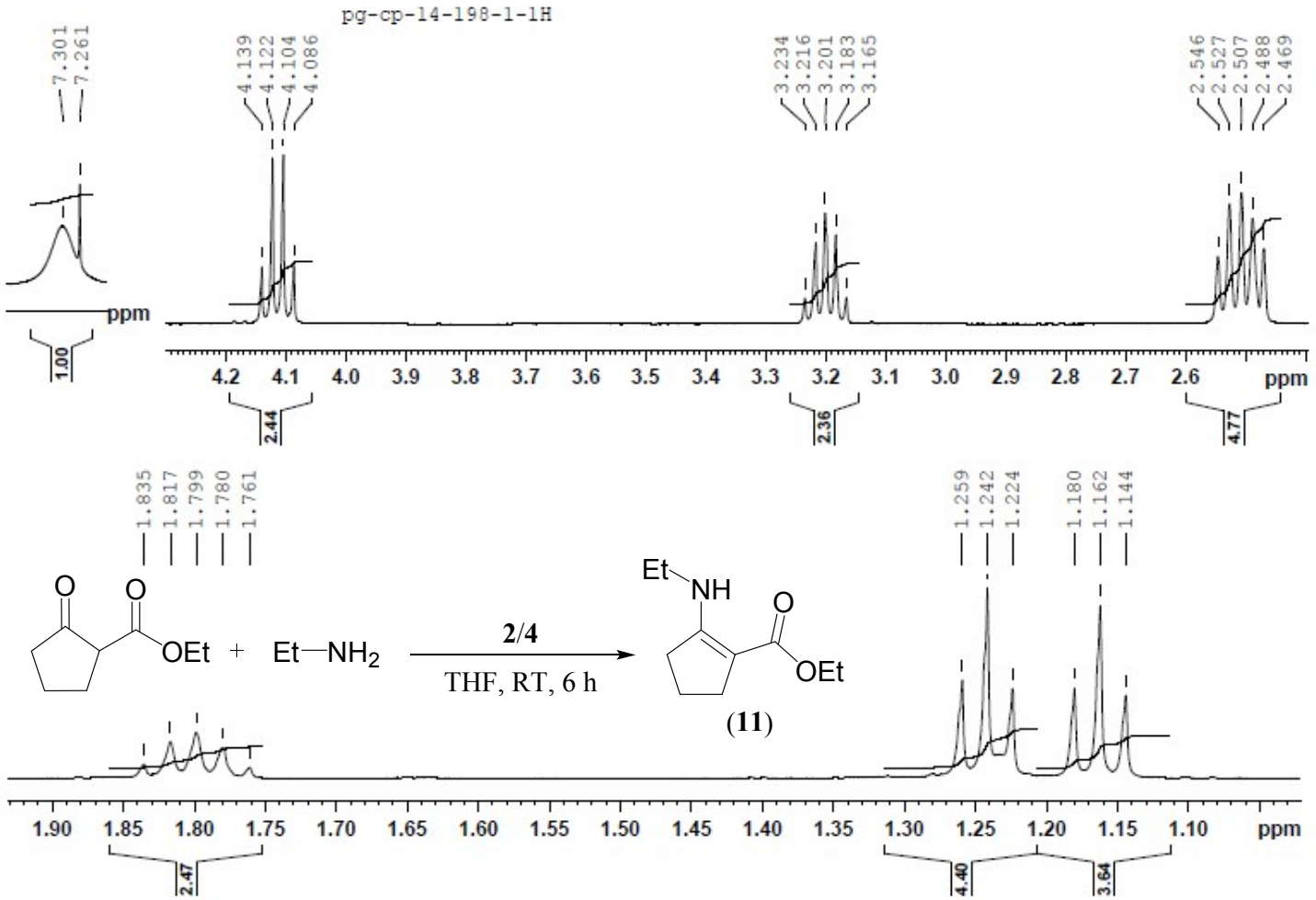


Fig. S46 Expanded ^{1}H NMR spectrum of **11** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

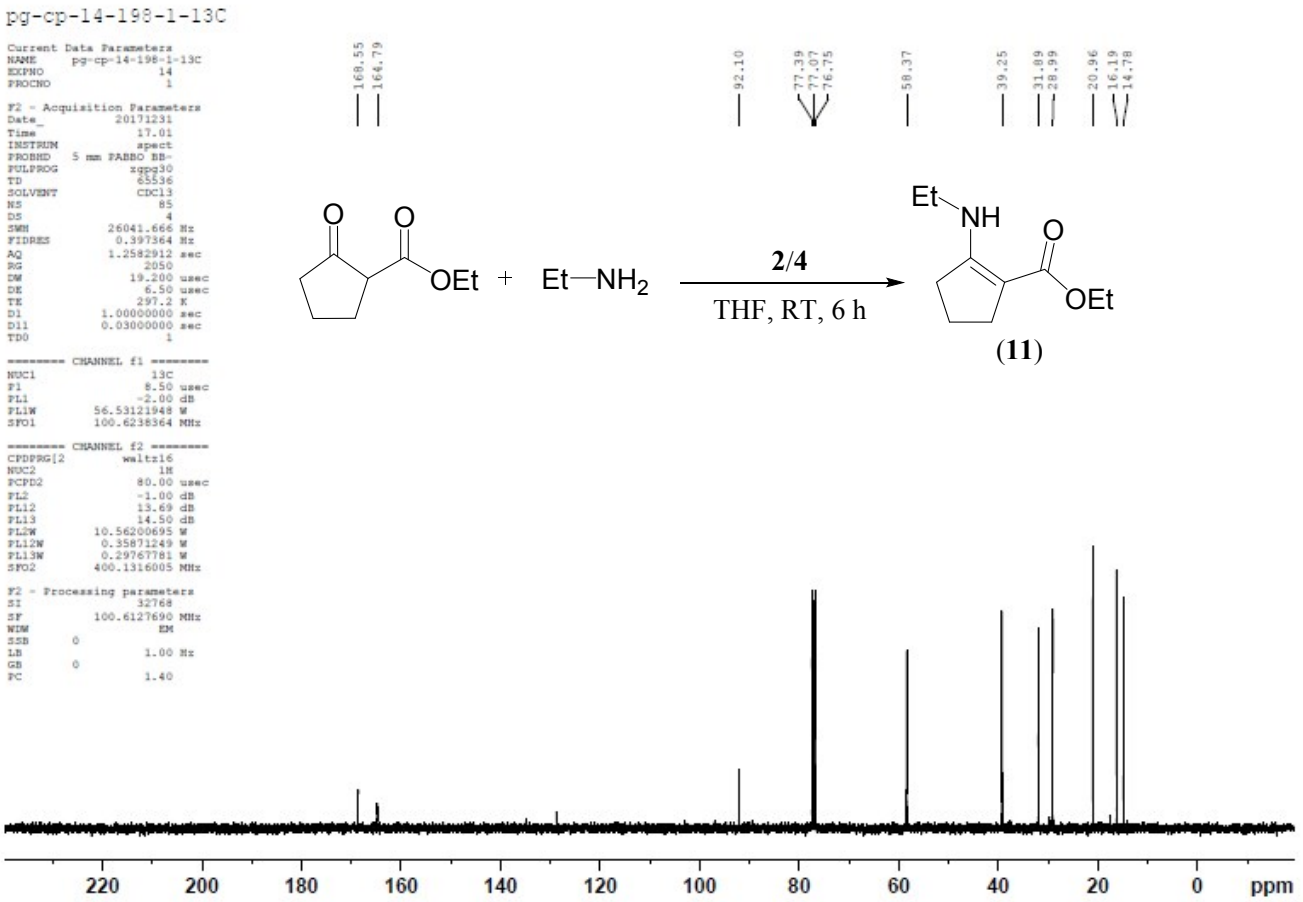


Fig. S47 $^{13}C\{^{1}H\}$ NMR spectrum of **11** in $CDCl_3$ formed in the reaction of acetyl acetone and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

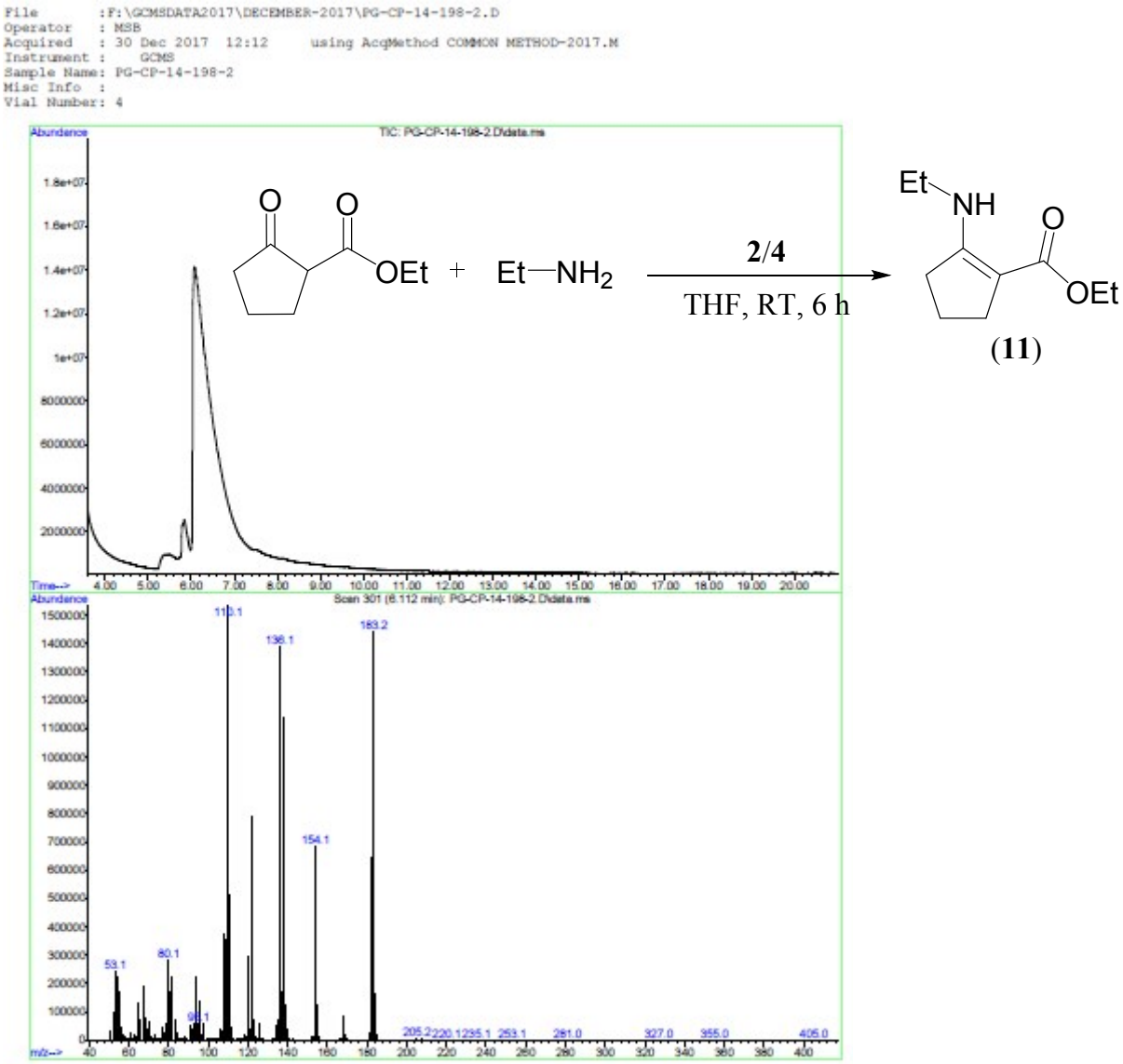
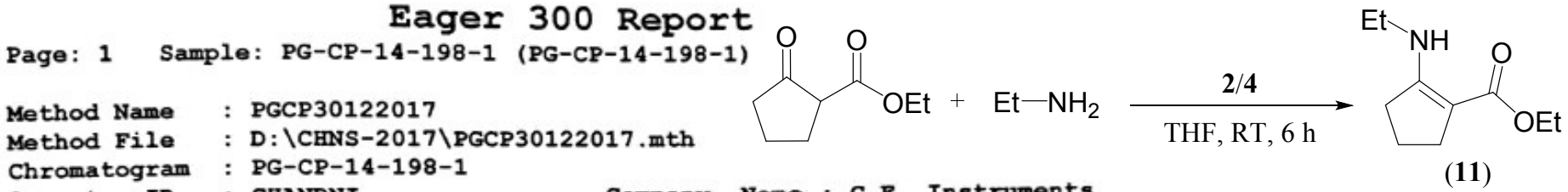


Fig. S48 GCMS trace of **11** (*m/z* 183) in EtOAc formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and ethyl amine as catalyzed by the the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.



(**11**)

Eager 300 Report

Page: 1 Sample: PG-CP-14-198-1 (PG-CP-14-198-1)

Method Name : PGCP30122017
Method File : D:\CHNS-2017\PGCP30122017.mth
Chromatogram : PG-CP-14-198-1
Operator ID : CHANDNI
Analysed : 12/30/2017 19:02
Sample ID : PG-CP-14-198-1 (# 14)
Analysis Type : UnkNown (Area)

Company Name : C.E. Instruments
Printed : 12/31/2017 22:03
Instrument N. : Instrument #1
Sample weight : 1.068

Calib. method : using 'K Factors'

!!! Warning missing one or more peaks.

Element Name	%	Ret.Time	Area	BC	Area ratio	K factor
1	0.0000	2	135514	RS		0.0000
Nitrogen	7.0577	41	81682	RS	22.042400	.108364E+07
Carbon	64.8684	63	1800456	RS	1.000000	.259525E+07
Hydrogen	9.1551	184	650466	RS	2.767948	.665260E+07
Totals	81.0812		2668118			

Fig.S49 Elemental analysis data of **11** formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and ethyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

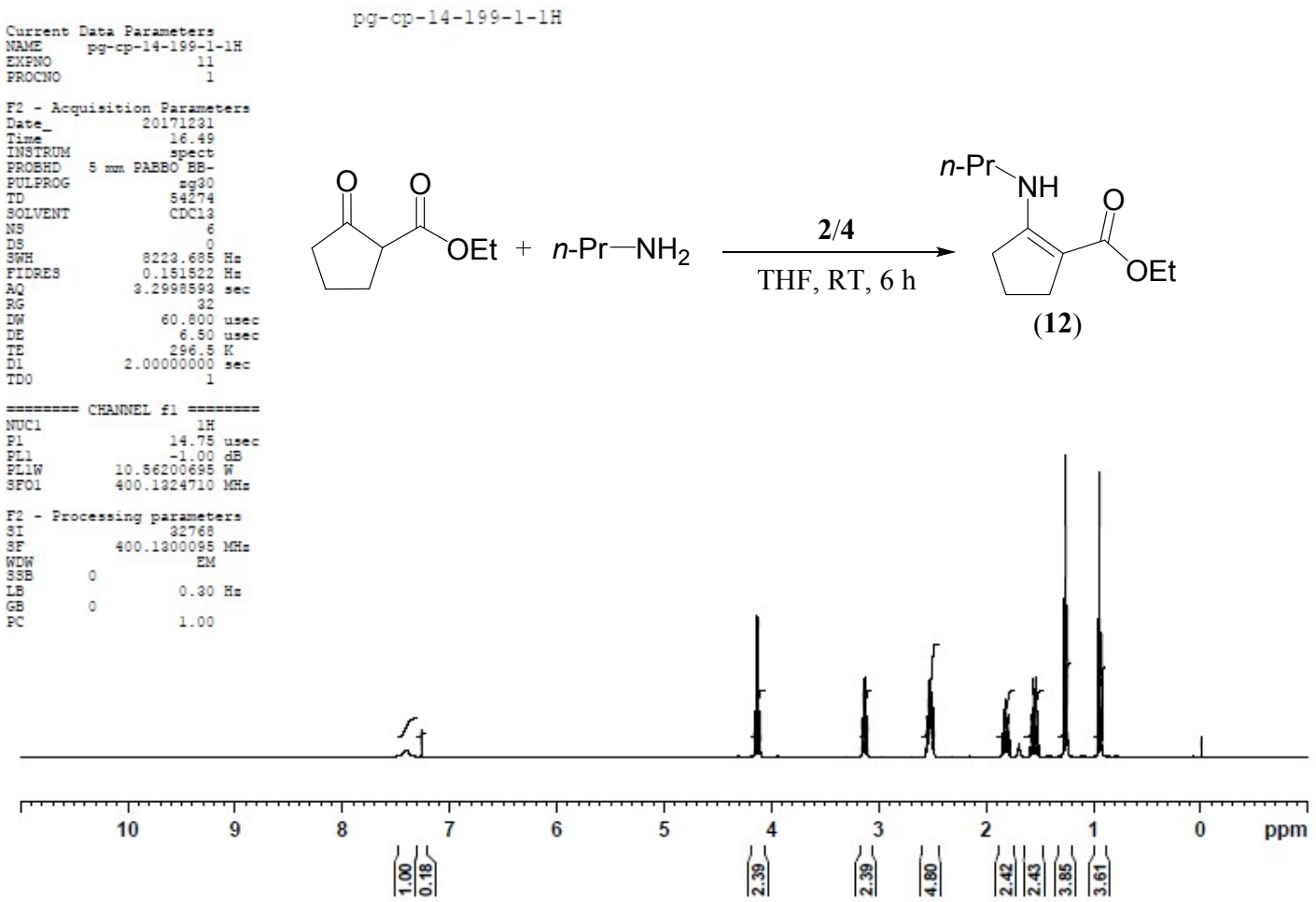


Fig.S50 ^{1}H NMR spectrum of **12** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and *n*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

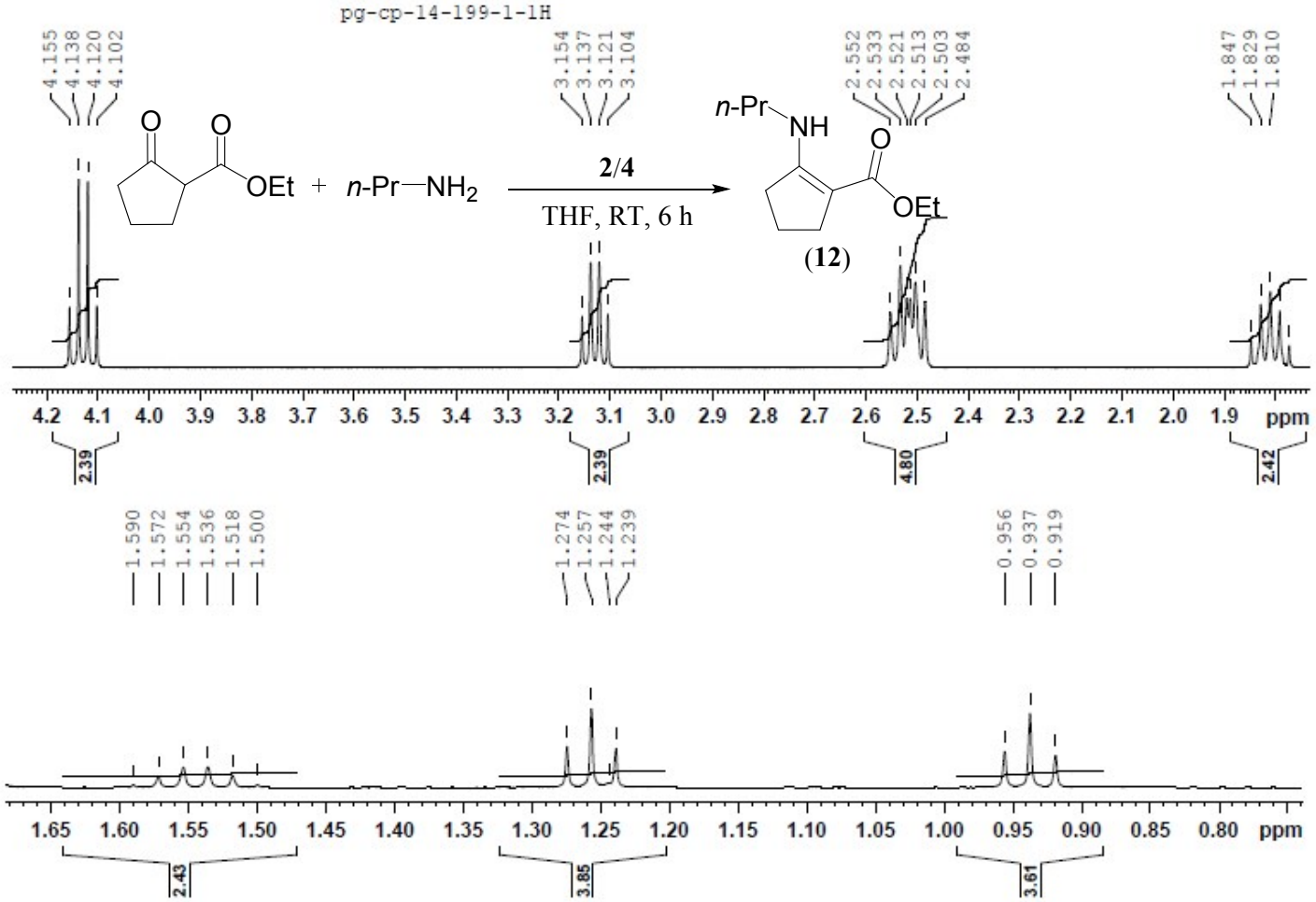


Fig. S51 Expanded ^{1}H NMR spectrum of **12** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and *n*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

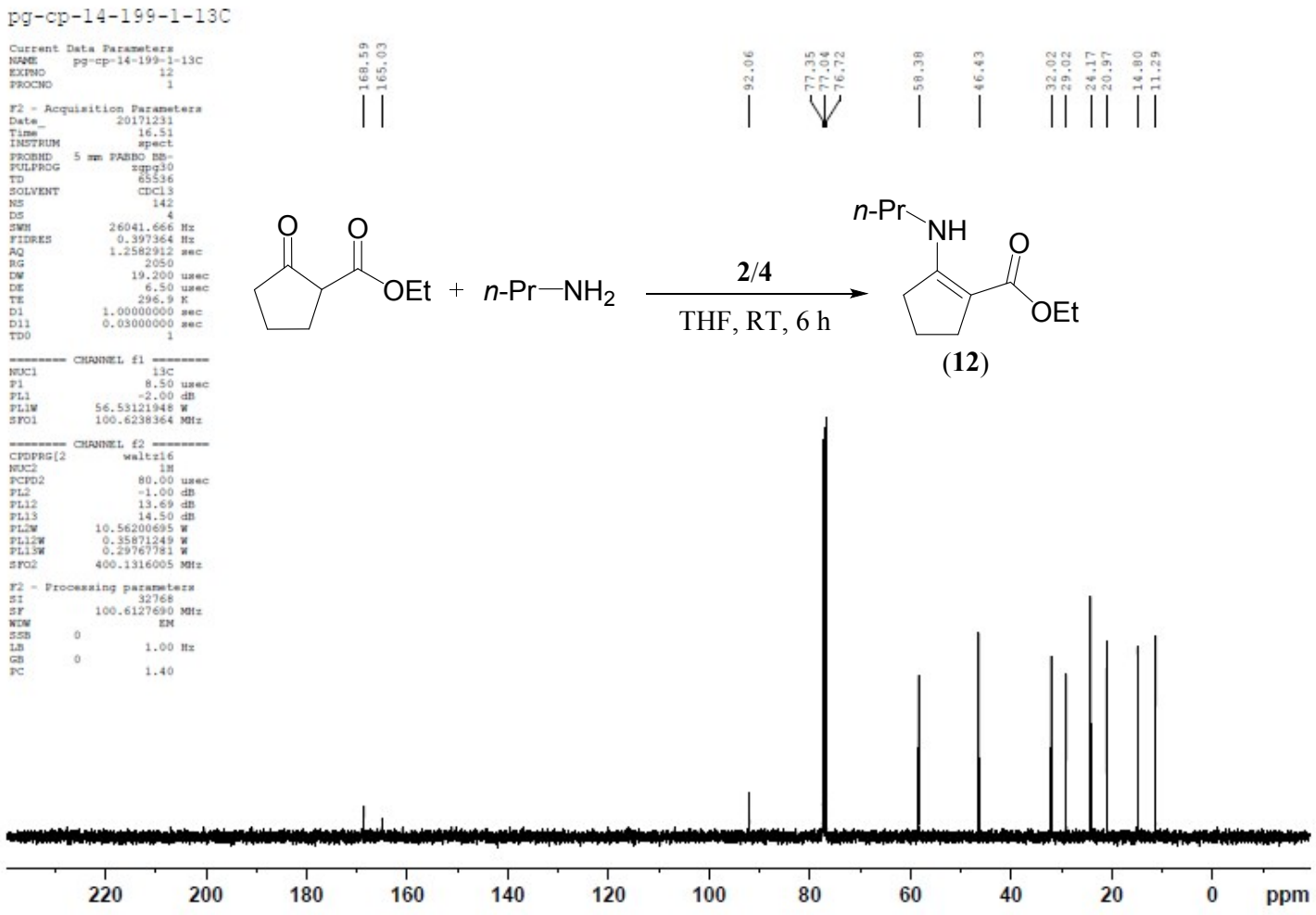


Fig. S52 $^{13}C\{^{1}H\}$ NMR spectrum of **12** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and *n*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

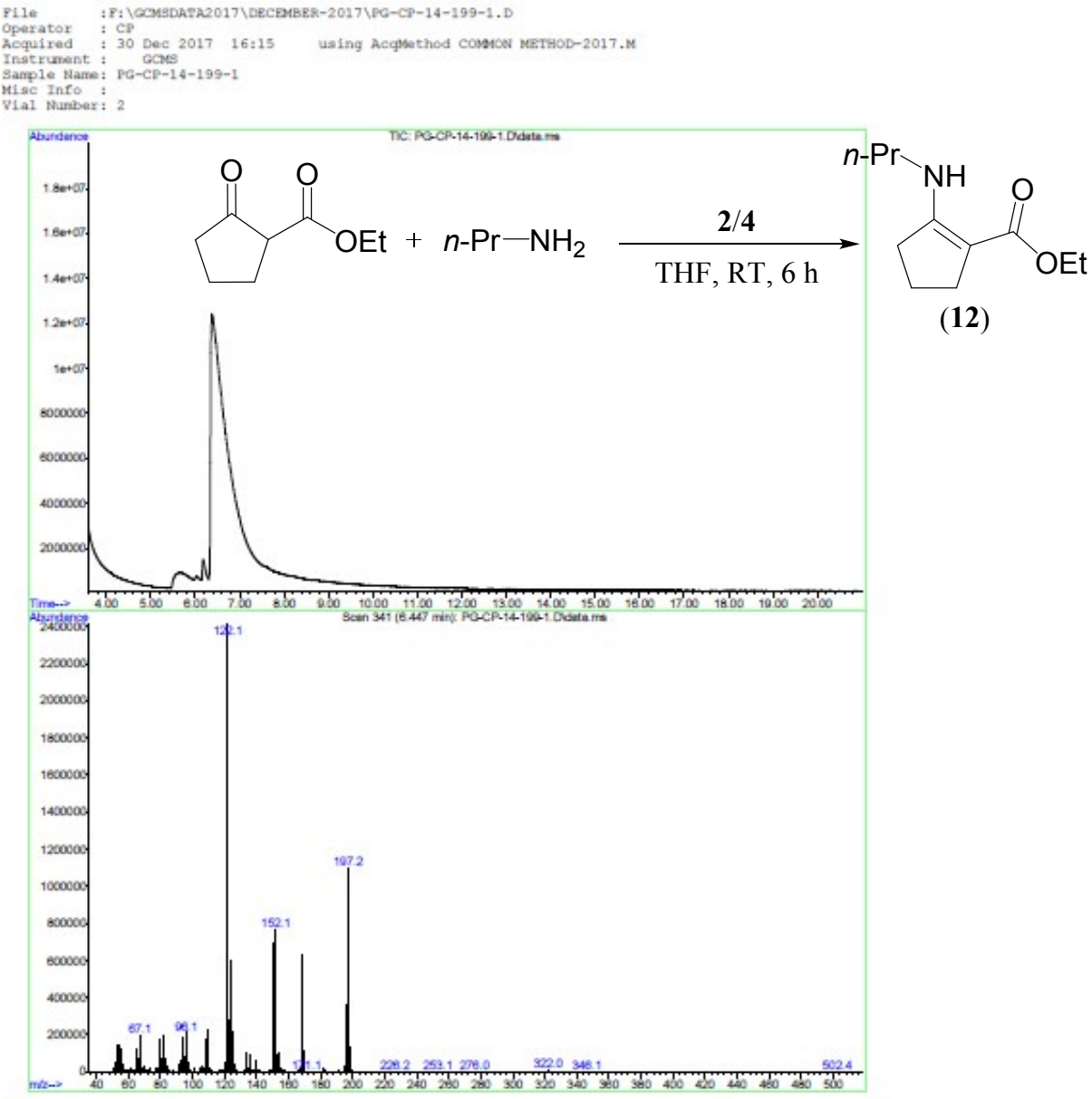


Fig. S53 GCMS trace of **12** (*m/z* 197) in EtOAc formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and *n*-propyl amine as catalyzed by the the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

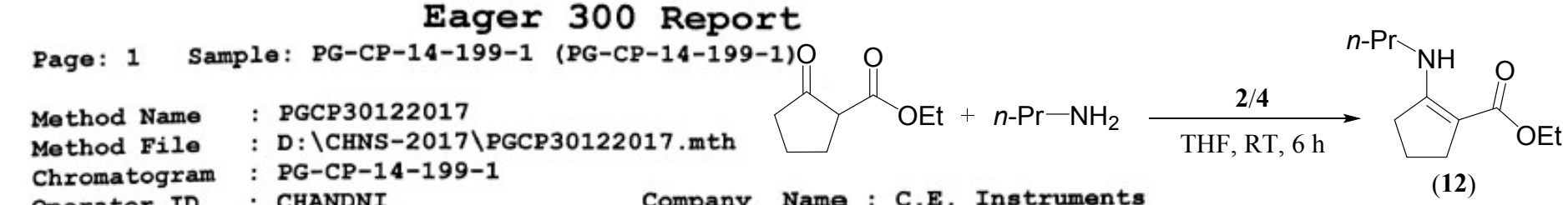


Fig. S54 Elemental analysis data of **12** formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and *n*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

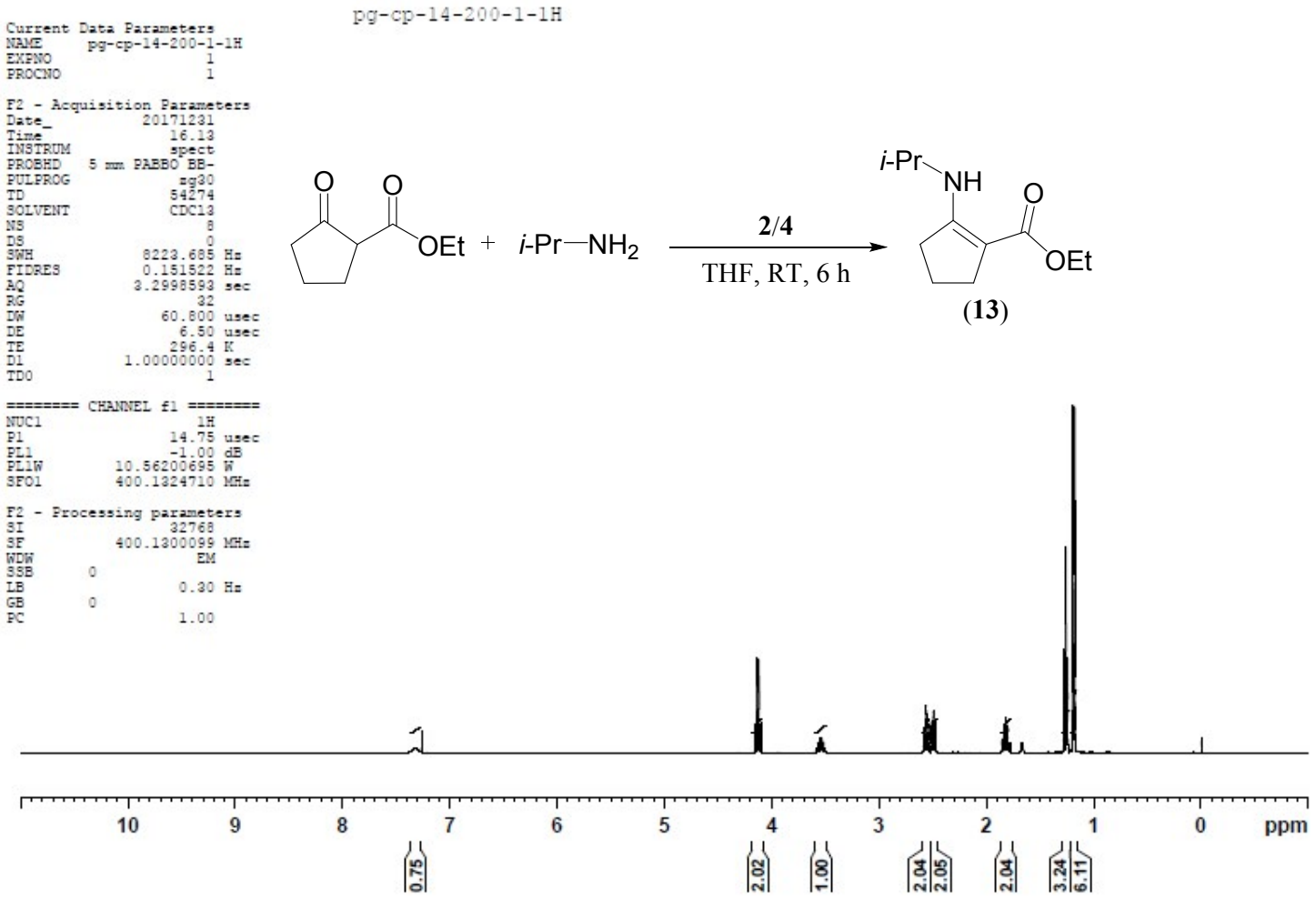


Fig. S55 ^{1}H NMR spectrum of **13** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and *i*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

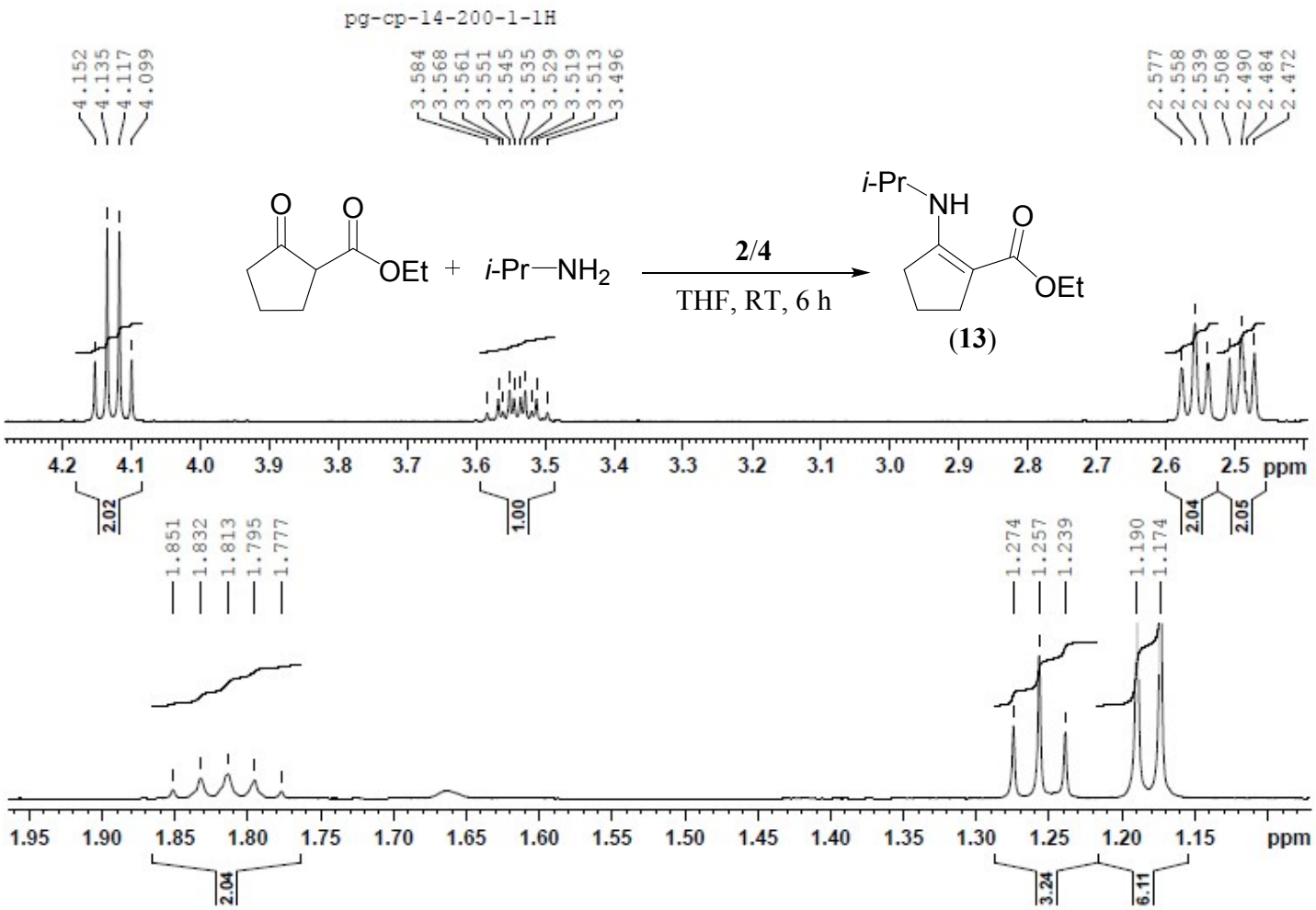


Fig. S56 Expanded ^{1}H NMR spectrum of **13** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and i-propyl amine as catalyzed by the dinuclear [CoL1]2 (**2**) and [CoL2]2 (**4**) complexes**.**

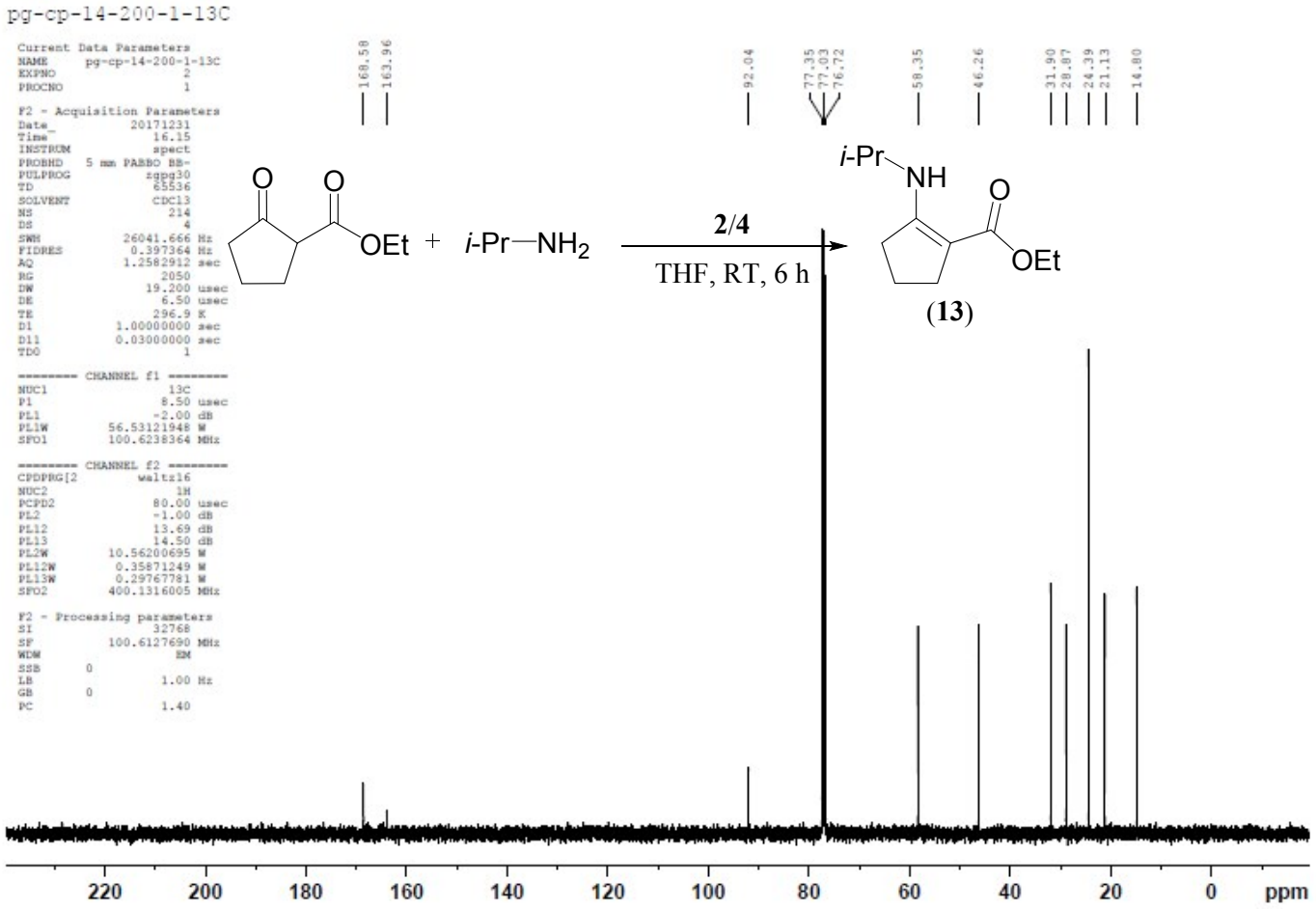


Fig. S57 $^{13}C\{^{1}H\}$ NMR spectrum of **13** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and *i*-propyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

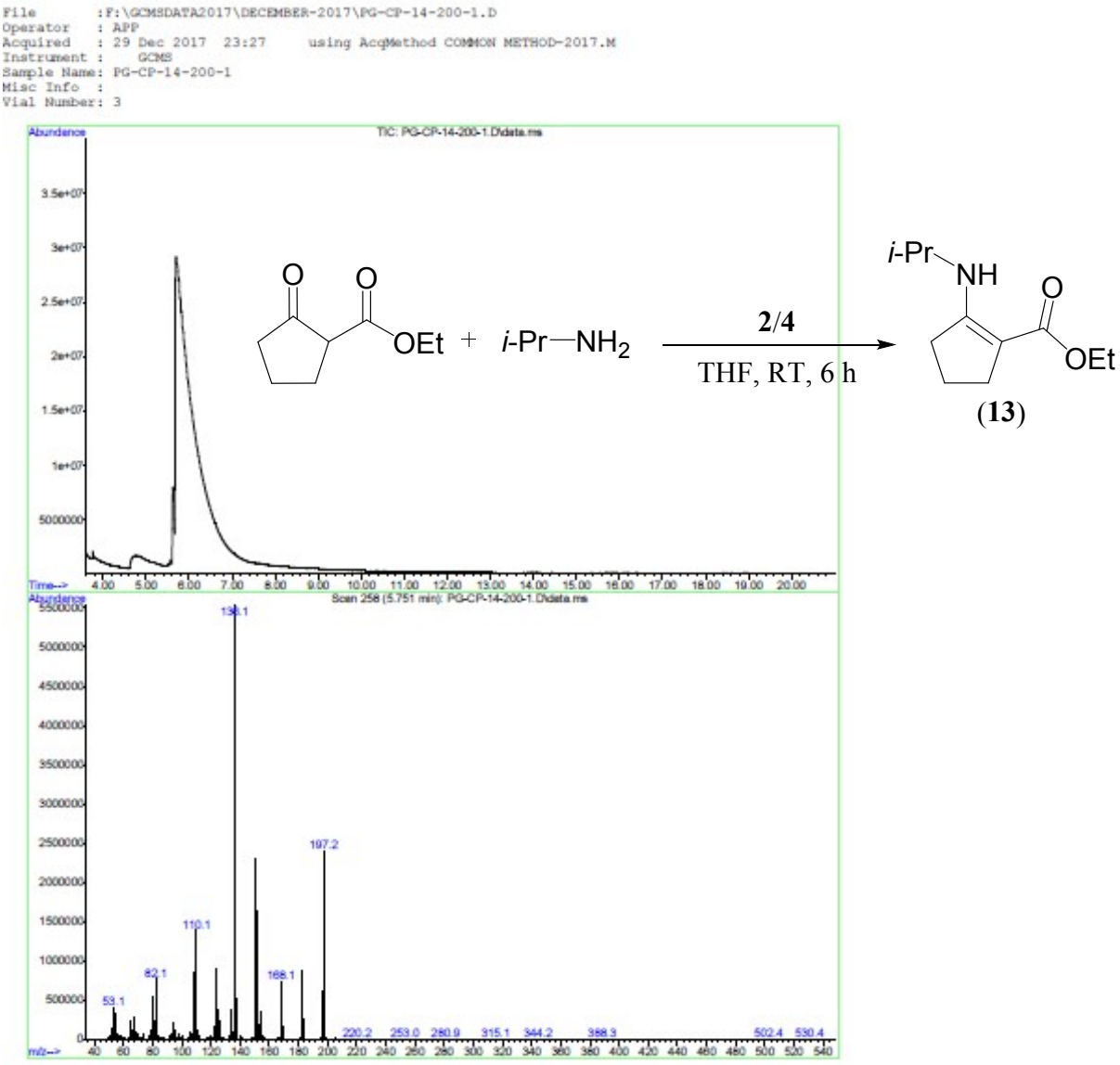


Fig. S58 GCMS trace of **13** (m/z 197) in EtOAc formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and i-propyl amine as catalyzed by the the dinuclear [CoL1]**2** (**2**) and [CoL2]**2** (**4**) complexes.

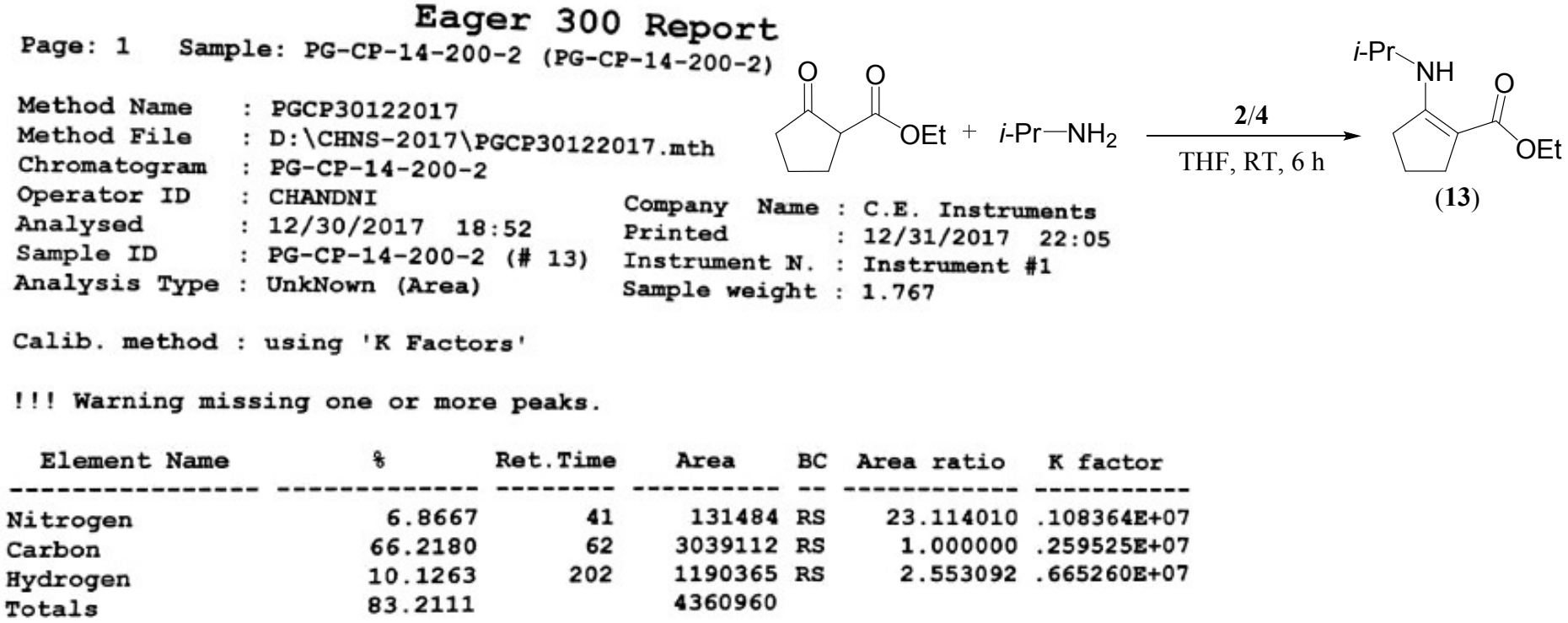


Fig. S59 Elemental analysis data of **13** formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and i-propyl amine as catalyzed by the dinuclear [CoL1]**2** (**2**) and [CoL2]**2** (**4**) complexes.

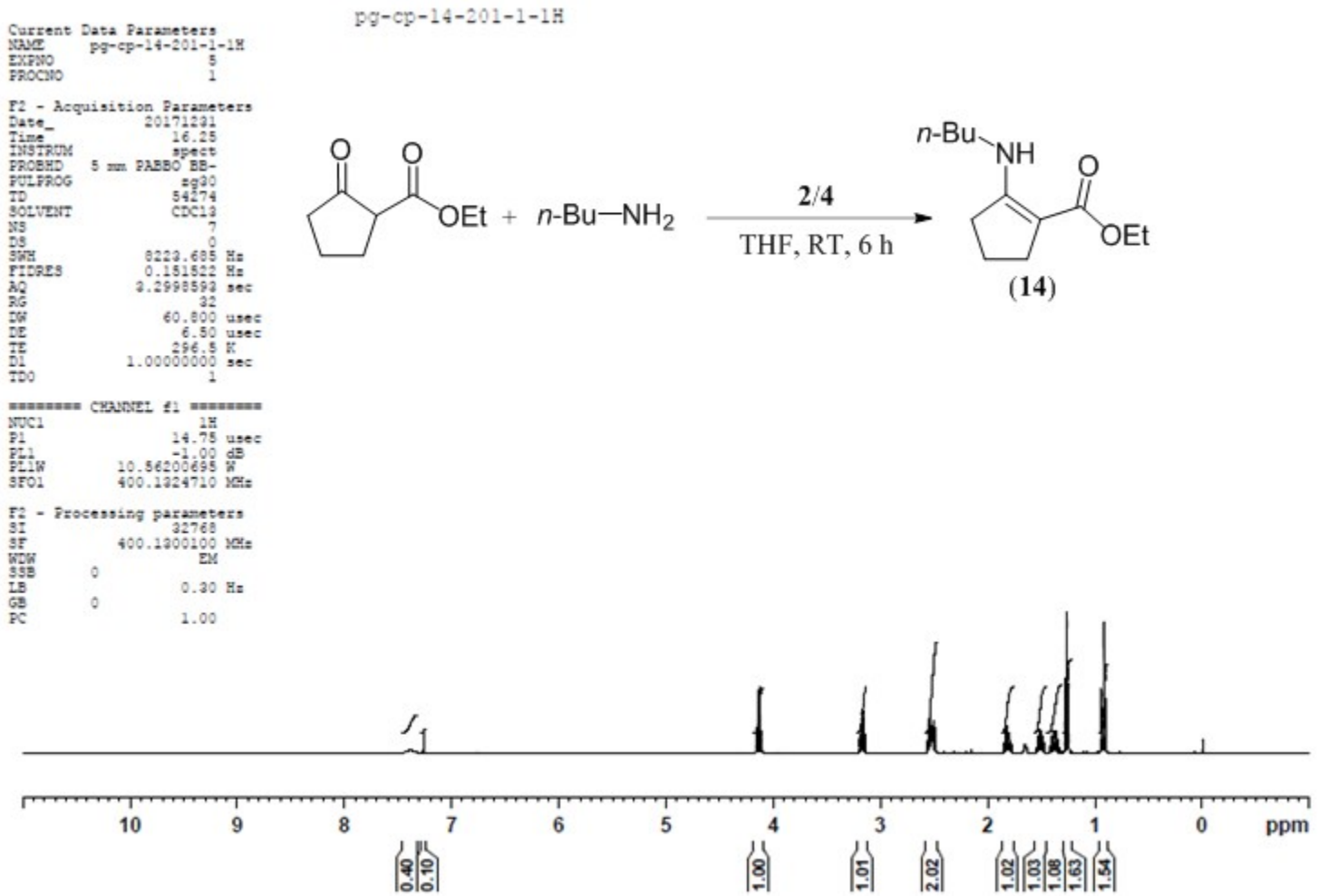


Fig. S60 1H NMR spectrum of **14** in CDCl3 formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and n-butyl amine as catalyzed by the dinuclear [CoL1]**2** (**2**) and [CoL2]**2** (**4**) complexes**.**

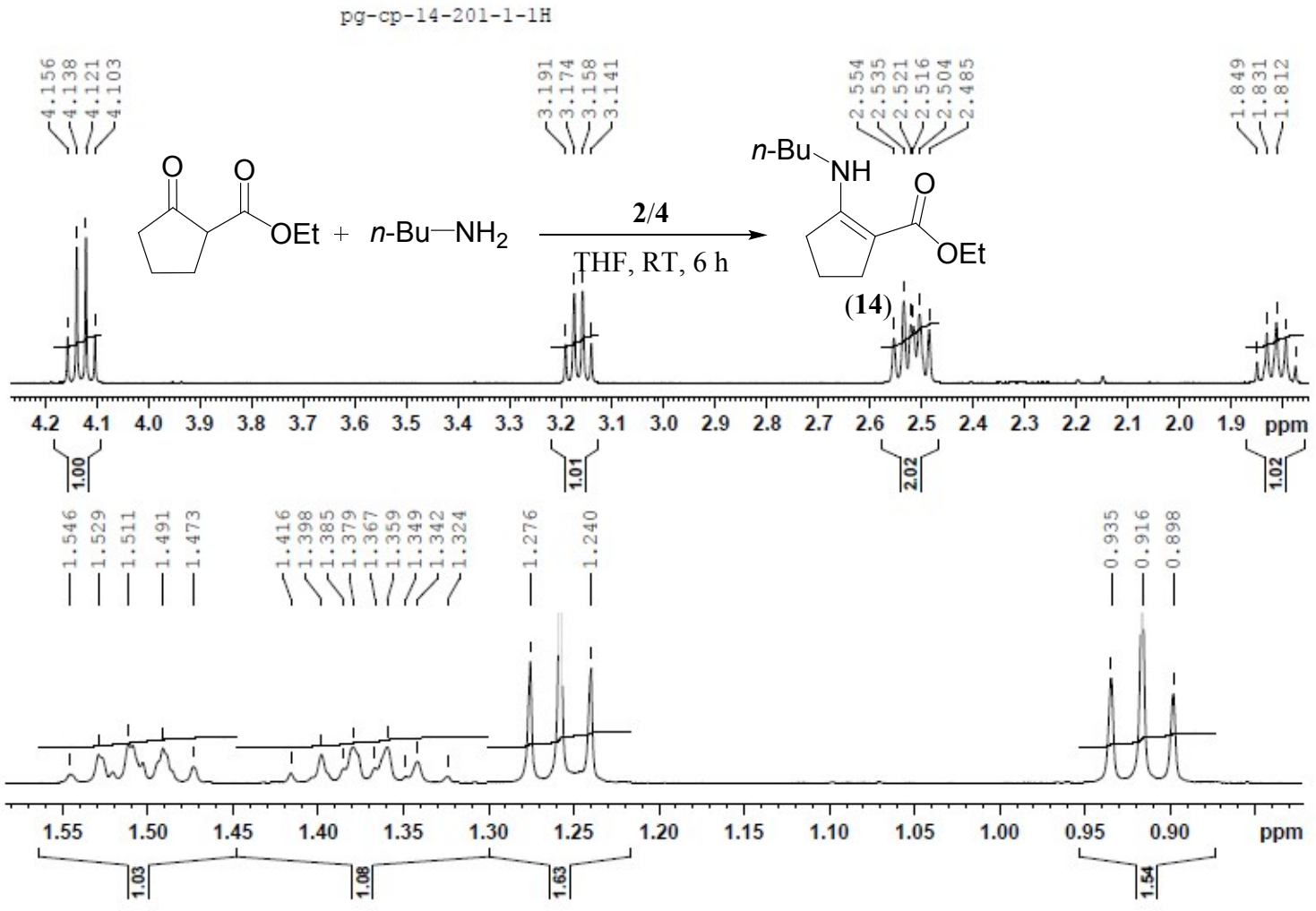


Fig. S61 Expanded 1H NMR spectrum of **14** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and n-butyl amine as catalyzed by the dinuclear [CoL1]**2** (**2**) and [CoL2]**2** (**4**) complexes**.**

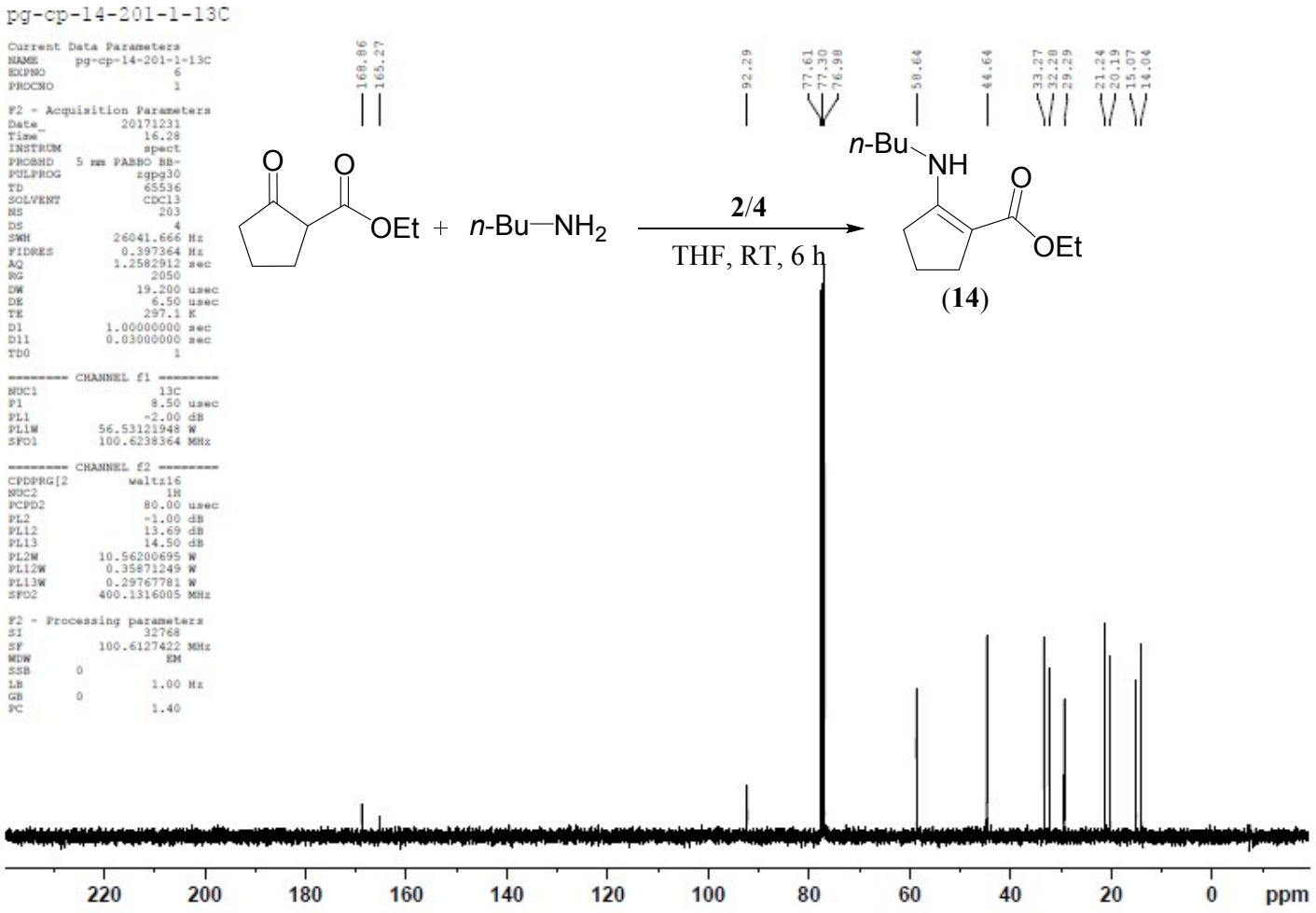


Fig. S62 $^{13}C\{^{1}H\}$ NMR spectrum of **14** in $CDCl_3$ formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and *n*-butyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

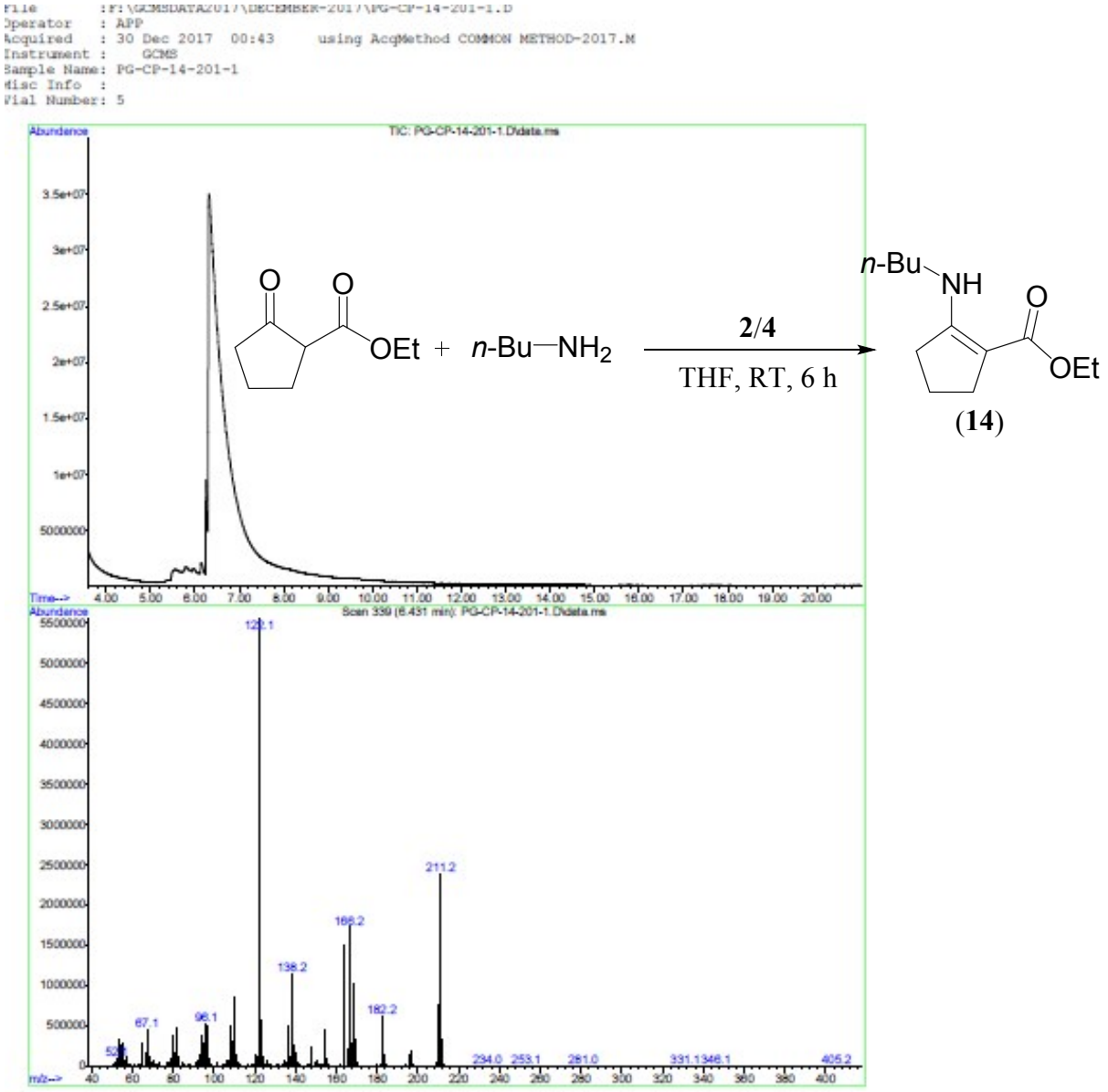
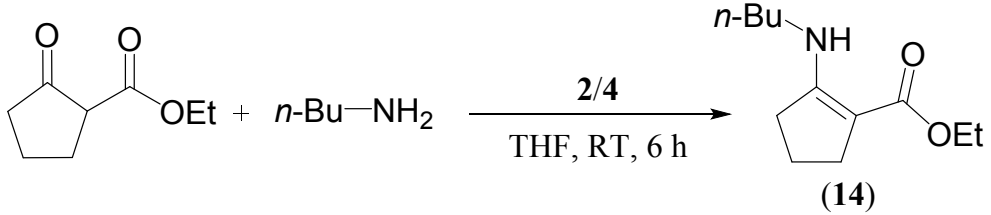


Fig. S63 GCMS trace of **14** (m/z 211) in EtOAc formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and n-butyl amine as catalyzed by the the dinuclear [CoL1]**2** (**2**) and [CoL2]**2** (**4**) complexes**.**



Eager 300 Report

Page: 1 Sample: PG-CP-14-201-1 (PG-CP-14-201-1)

Method Name	: PGCP30122017		
Method File	: D:\CHNS-2017\PGCP30122017.mth		
Chromatogram	: PG-CP-14-201-1		
Operator ID	: CHANDNI	Company Name	: C.E. Instruments
Analysed	: 12/30/2017 19:22	Printed	: 12/31/2017 22:05
Sample ID	: PG-CP-14-201-1 (# 16)	Instrument N.	: Instrument #1
Analysis Type	: UnkNown (Area)	Sample weight	: 1.565

Calib. method : using 'K Factors'

!!! Warning missing one or more peaks.

Element Name	%	Ret.Time	Area	BC	Area ratio	K factor
1	0.0000	2	131749	RS		0.0000
Nitrogen	6.5050	41	110319	RS	24.843690	.108364E+07
Carbon	67.4186	62	2740732	RS	1.000000	.259525E+07
Hydrogen	10.2791	199	1070187	RS	2.560984	.665260E+07
Totals	84.2027		4052987			

Fig. S64 Elemental analysis data of **14** formed in the reaction of ethyl 2-oxocyclopentanecarboxylate and *n*-butyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes.

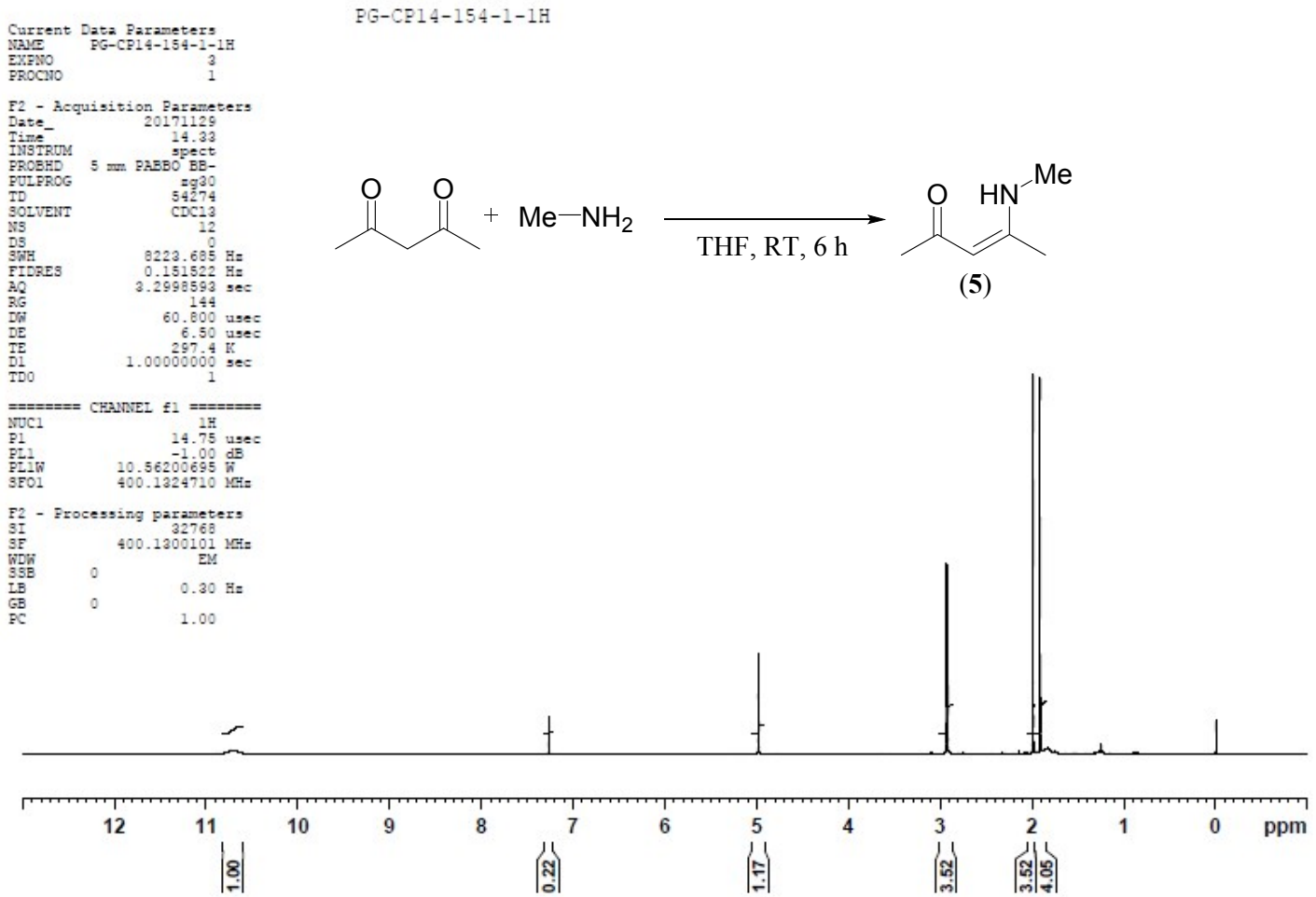


Fig. S65 ^{1}H NMR spectrum of **5** in $CDCl_3$ formed in the reaction of acetyl acetone and methyl amine.

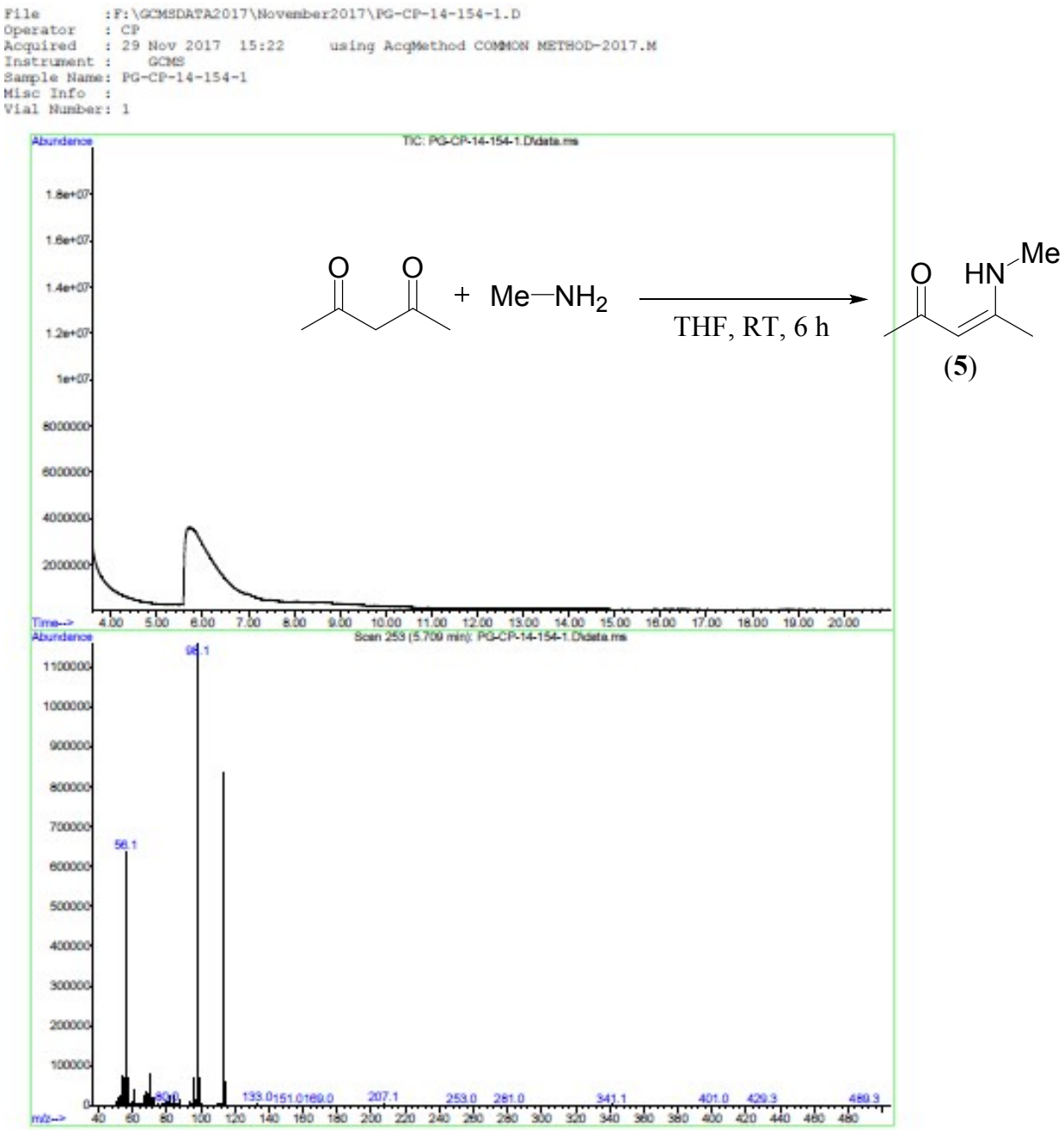


Fig. S66 GCMS trace of **5** (*m/z* 113) in EtOAc formed in the reaction of acetyl acetone and methyl amine.

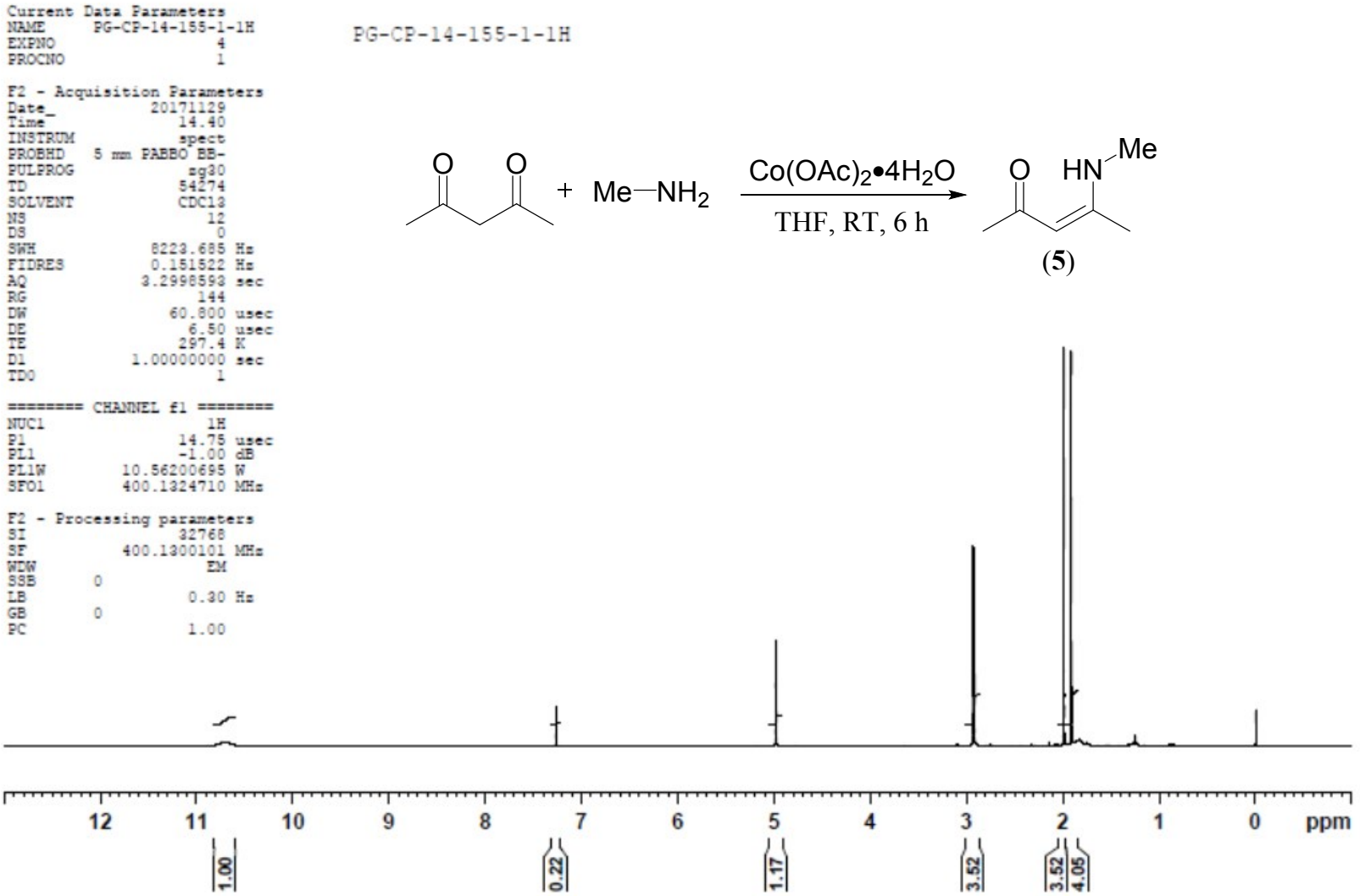


Fig. S67 1H NMR spectrum of **5** in CDCl3 formed in the reaction of acetyl acetone and methyl amine as catalyzed by Co(OAc)2•4H2O**.**

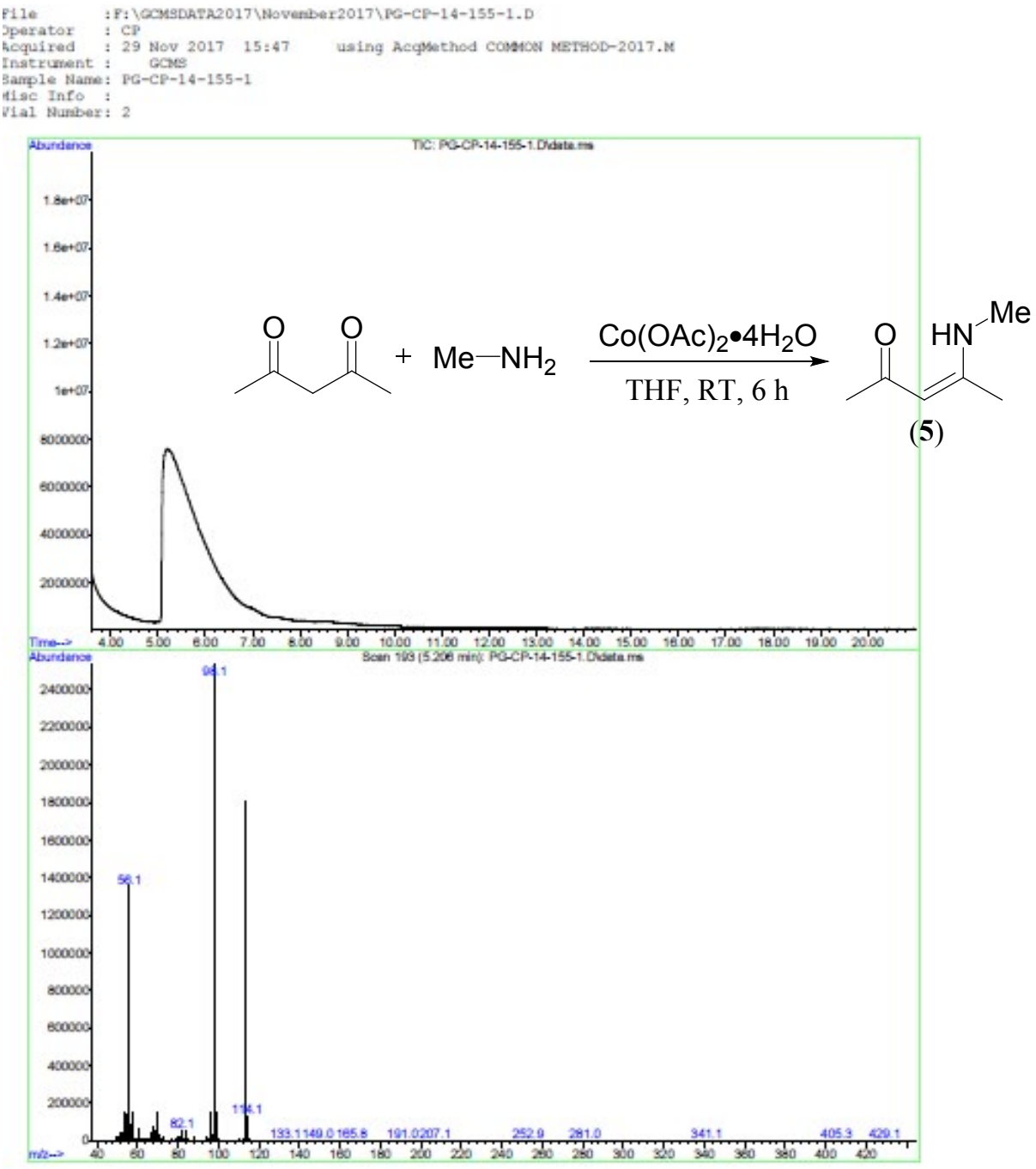


Fig. S68 GCMS trace of **5** (m/z 113) in EtOAc formed in the reaction of acetyl acetone and methyl amine as catalyzed by Co(OAc)2•4H2**O.**

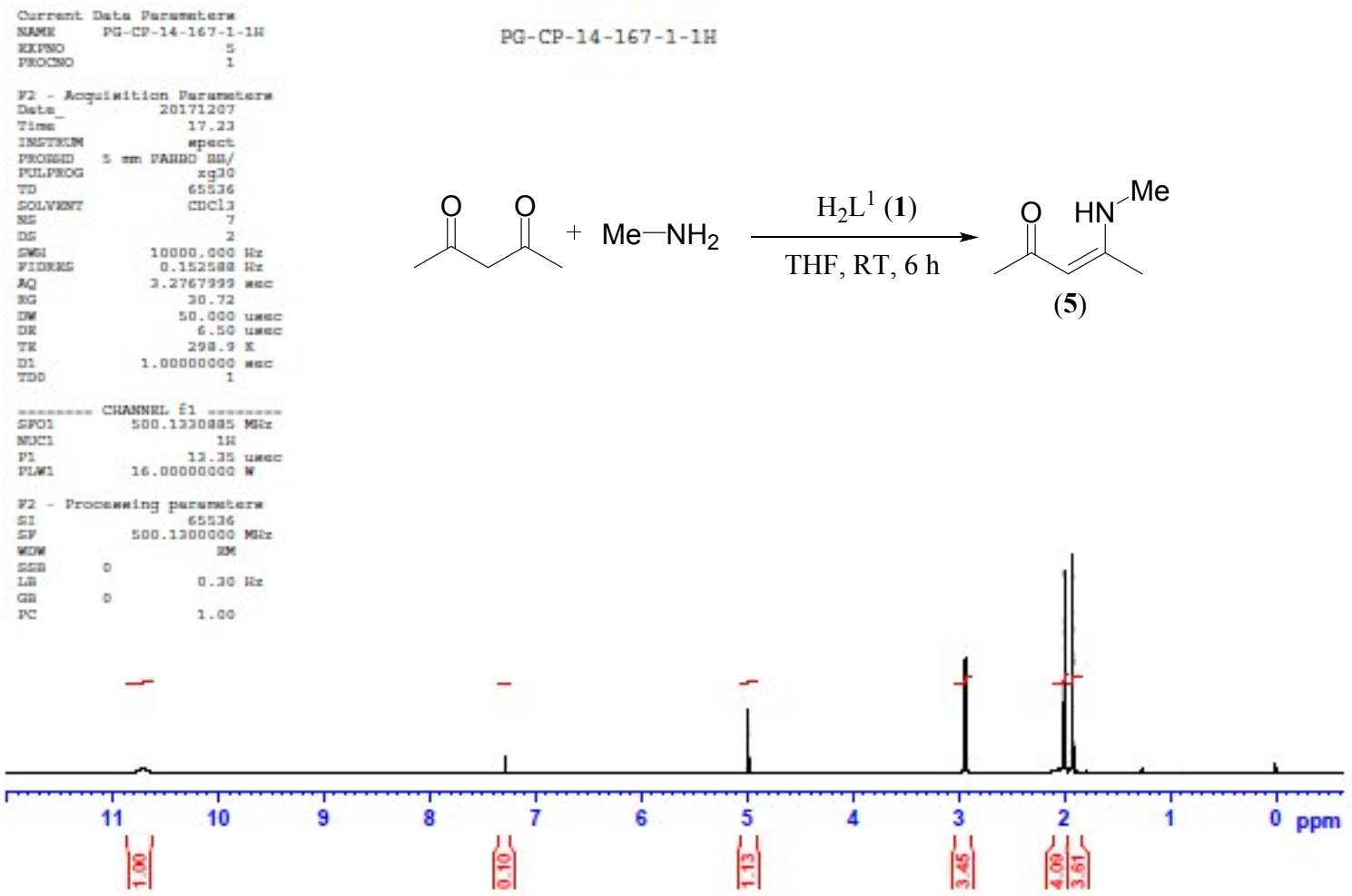


Fig. S69 ^{1}H NMR spectrum of 5 in $CDCl_3$ formed in the reaction of acetyl acetone and methyl amine as catalyzed by H_2L^1 (**1**)**.**

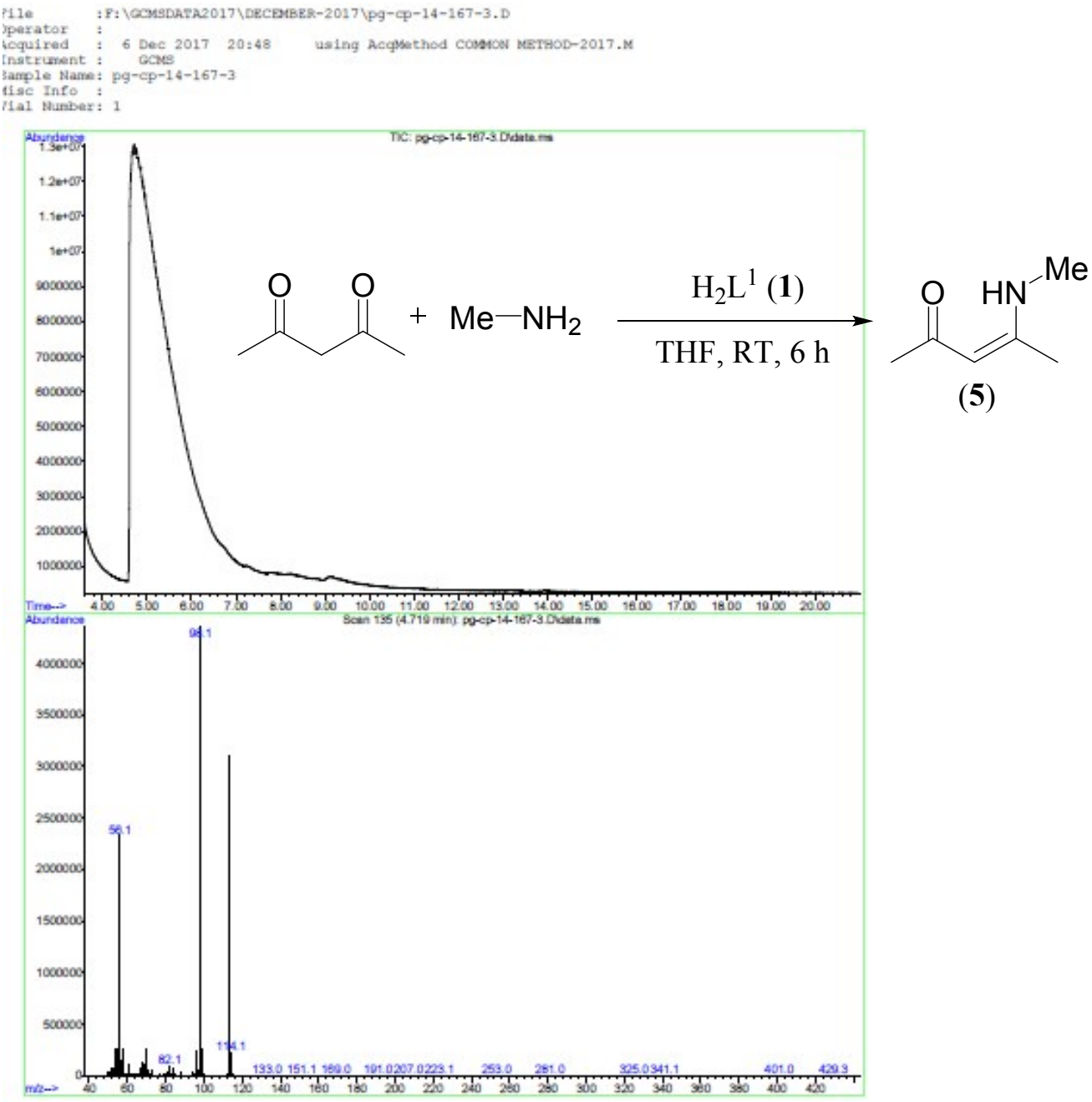


Fig. S70 GCMS trace of **5** (*m/z* 113) in EtOAc formed in the reaction of acetyl acetone and methyl amine as catalyzed by H_2L^1 (**1**)**.**

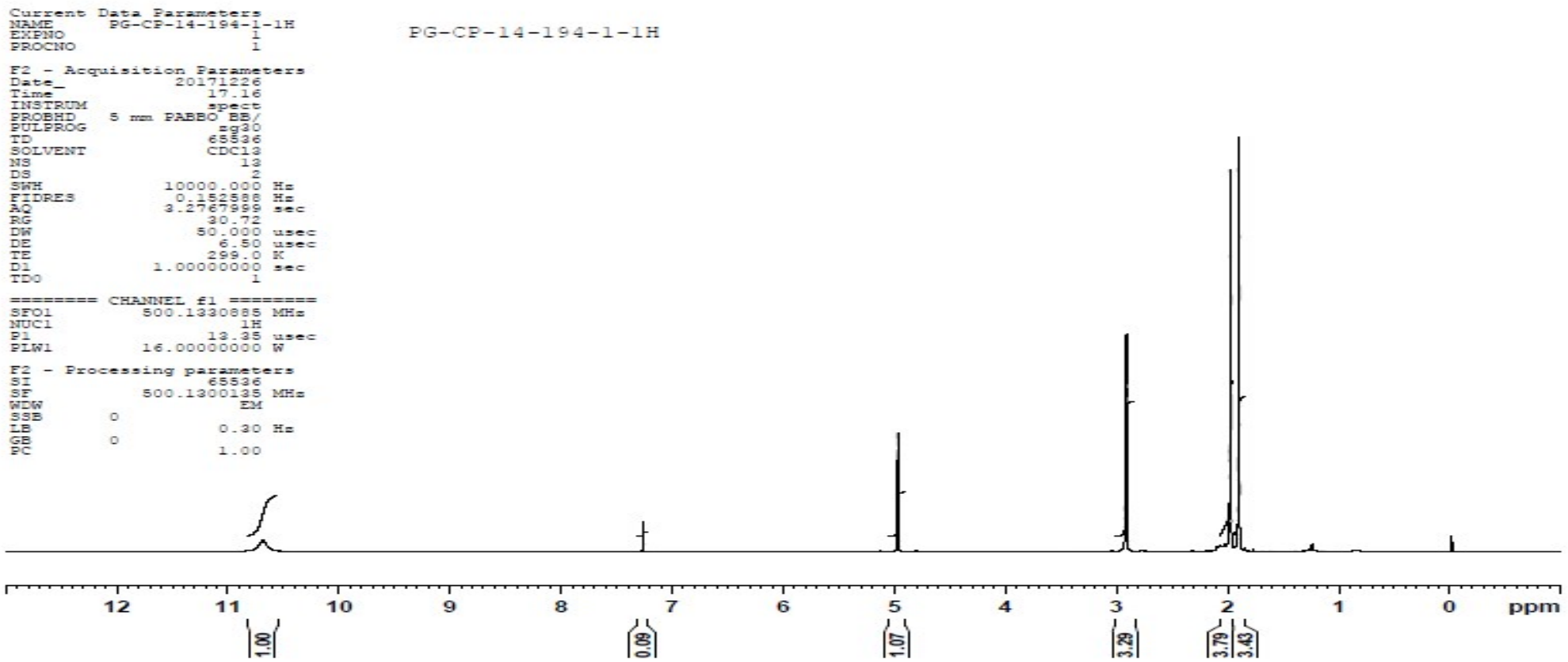


Fig. S71 ^{1}H NMR spectrum of 5 in $CDCl_3$ formed in the reaction of acetyl acetone and methyl amine as catalyzed by H_2L^2 **(3).**

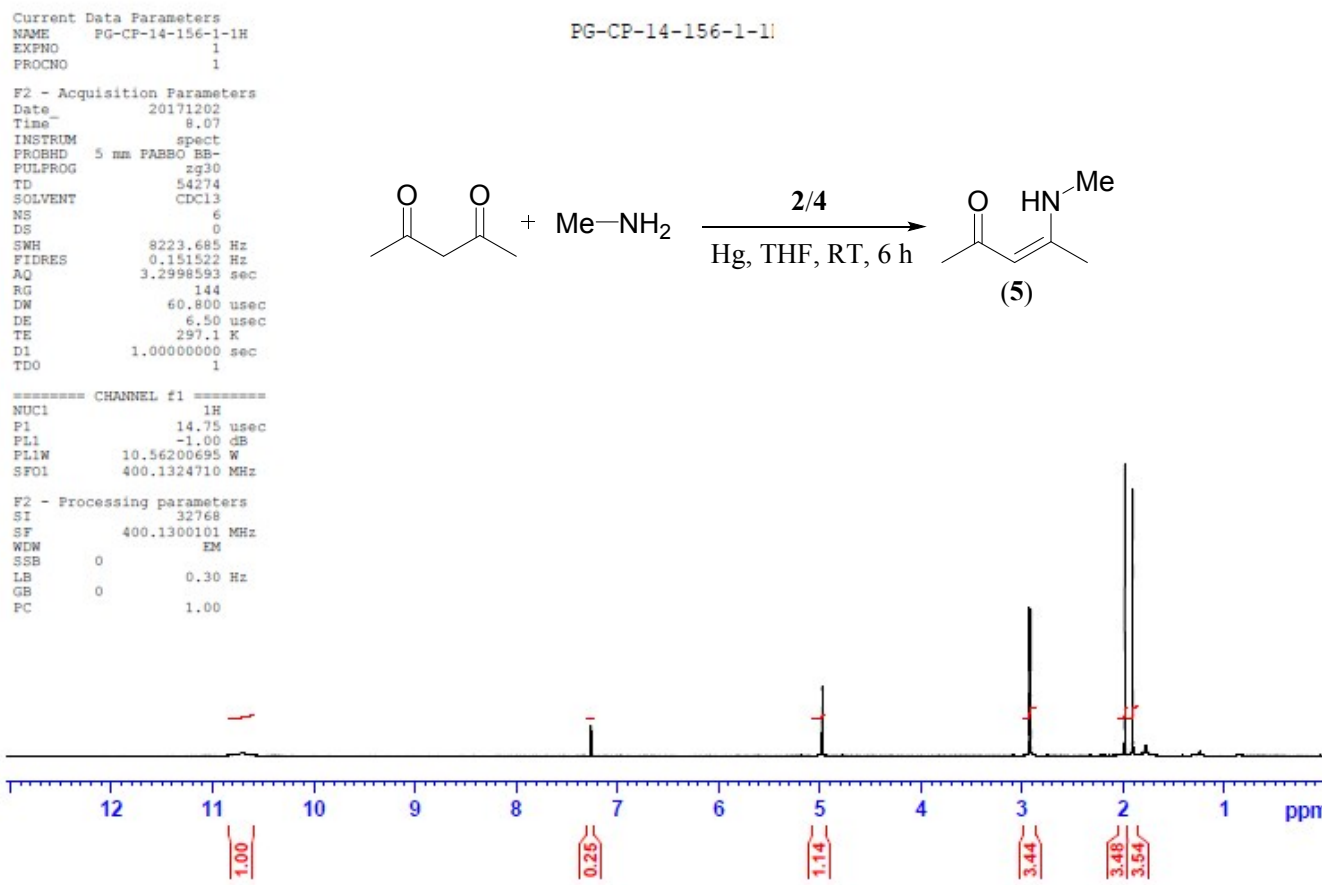
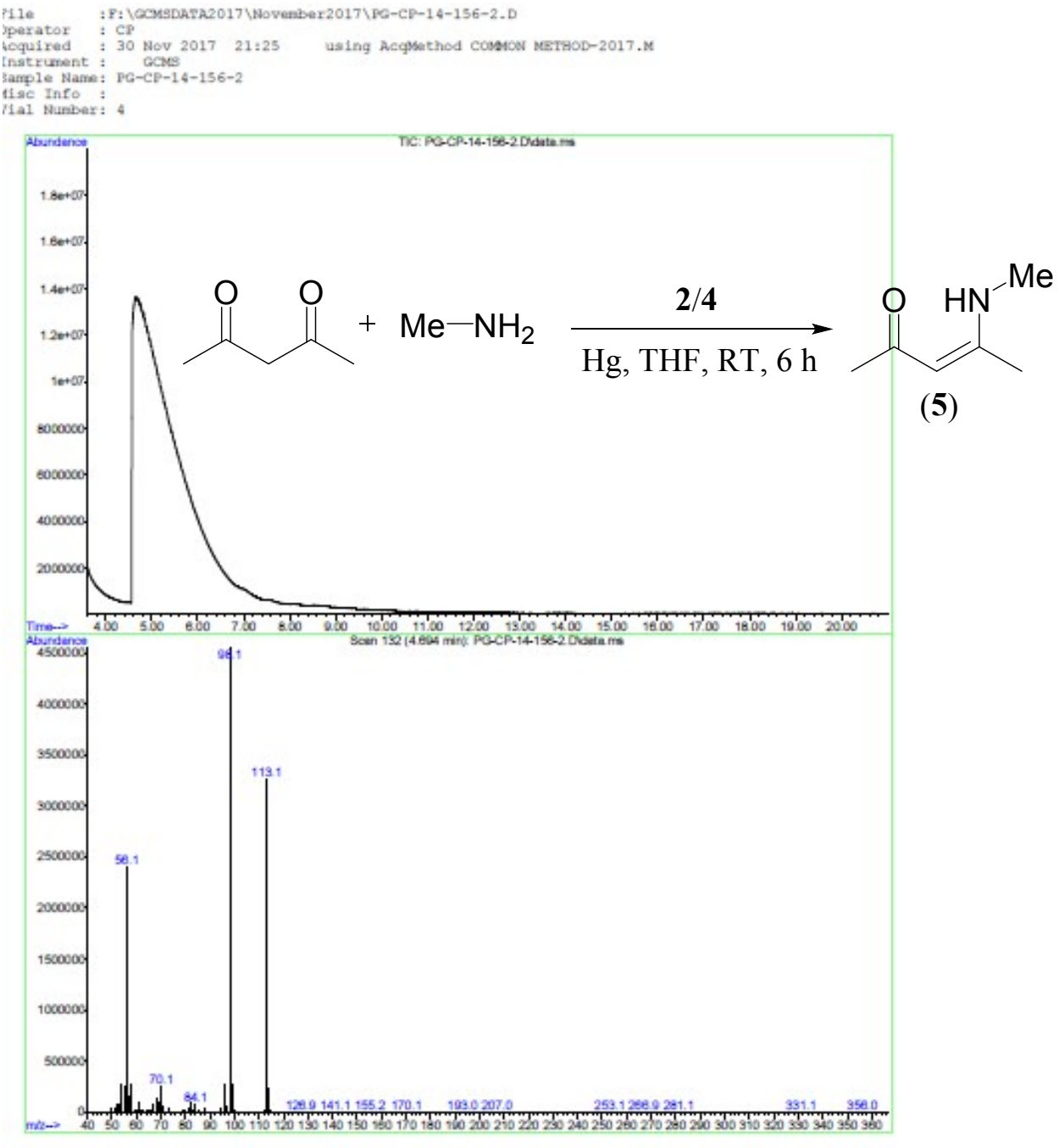


Fig. S72 1H NMR spectrum of **5** in $CDCl_3$ formed in the reaction of acetyl acetone and methyl amine as catalyzed by the dinuclear [CoL1]**2** (**2**) and [CoL2]**2** (**4**) complexes in the presence of Hg**.**



(**5**)

Fig. S73 GCMS trace of **5** (*m/z* 113) in EtOAc formed in the reaction of acetyl acetone and methyl amine as catalyzed by the dinuclear $[CoL^1]_2$ (**2**) and $[CoL^2]_2$ (**4**) complexes in the presence of Hg.