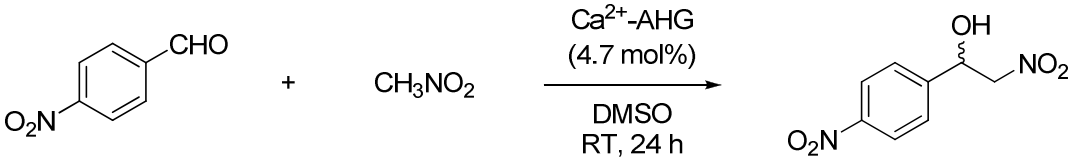
Supporting Information

3. Metal Alginate-catalyzed Nitroaldol (Henry) Reaction

Table of Contents

1. Preliminary optimization experiments

Table S1. Determination of the ideal amount of nitromethane.[a]

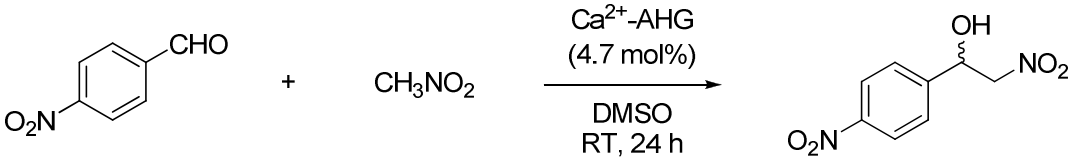


1 **2** **3a**

Entry	eq. $MeNO_2$	Yield (%)[b]
1	5	77
2	10	88

[a] Reaction conditions: 4-nitrobenzaldehyde (0.1 mmol), nitromethane (0.5 or 1.0 mmol), 1 unit of Ca^{2+}-AHG bead, DMSO (0.5 mL), room temperature, 24 h; [b] Determined by ^{1}H NMR analysis of the crude product.

Table S2. Determination of the ideal amount of 4-nitrobenzaldehyde (2).[a]



1 **2** **3a**

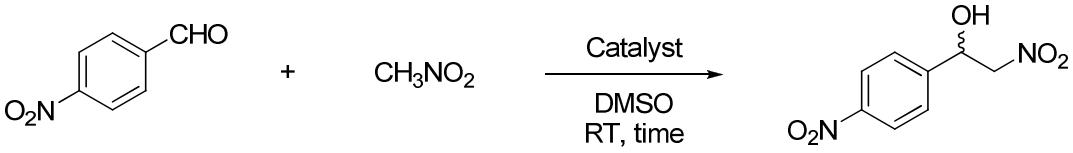
Entry	mmol (2)	Yield (%)[b]
1	0.1	88
2	0.3	33

[a] Reaction conditions: 4-nitrobenzaldeyhde (0.1 or 0.3 mmol), nitromethane (10 eq.), 1 unit of Ca^{2+}-AHG bead, DMSO (0.5 mL), room temperature, 24 h; [b] Determined by ^{1}H NMR analysis of the crude product.

2. Additional experiments

Nanoreactor experiment

Table S3. Nanoreactor experiment: Comparison of the outcome between one whole Ca^{2+}-AHG bead and one halved Ca^{2+}-AHG bead.[a]



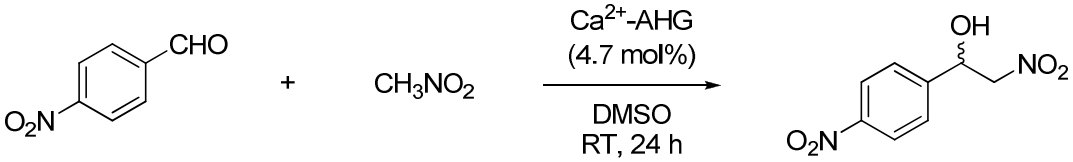
1 **2** **3a**

Entry	time (h)	Yield (%)[b] Whole Bead	Yield (%)[b] Halved Bead
1	1	8	9
2	2	15	17
3	3	21	29
4	4	31	40

[a] Reaction conditions: 4-nitrobenzaldehyde (0.1 mmol), nitromethane (1.0 mmol), 1 whole or 1 halved Ca^{2+}-AHG bead, DMSO (0.5 mL), room temperature; [b] Determined by ^{1}H NMR analysis of the crude product.

Recycling experiment

Table S4. Proof of the recyclability of the Ca^{2+}-AHG beads.[a]



1 **2** **3a**

Entry	Run	Yield (%)[b]
1	1	88
2	2	85
3	3	83
4	4	72
5	5	64

[a] Reaction conditions: 4-nitrobenzaldehyde (0.1 mmol), nitromethane (1.0 mmol), 1 unit of Ca^{2+}-AHG bead, DMSO (0.5 mL), room temperature, 24 h; [b] Determined by ^1H NMR analysis of the crude product.

3. Metal loading

Table S5. Determination of the metal content of the used M^{n+}-AHG beads by ICP-OES.[a]

Entry	M^{n+}	Loading (μmol/bead)
1	Ca^{2+}-AHG	4.76
2	Cu^{2+}-AHG	3.23
3	Co^{2+}-AHG	3.57
4	Ni^{2+}-AHG	2.99
5	Zn^{2+}-AHG	3.56
6	Fe^{3+}-AHG	4.26

[a] Sample preparation was performed like previously reported.[1] 20 randomly chosen M^{n+}-AHG beads were dissolved in conc. HNO_3 for each case.

4. Leaching study

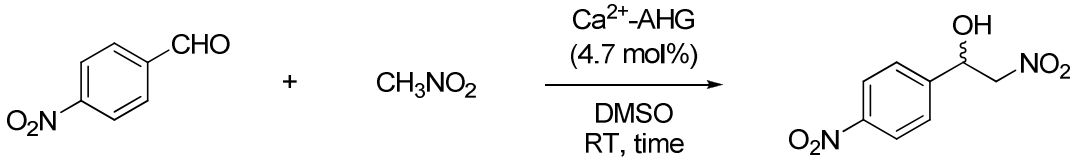
Table S6. Metal leaching of the used M^{n+}-AHG beads as a function of solvent.[a]

	c(M^{n+}) / (mmol/L)					
Solvent	**Ca^{2+}-AHG**	**Cu^{2+}-AHG**	**Co^{2+}-AHG**	**Ni^{2+}-AHG**	**Zn^{2+}-AHG**	**Fe^{3+}-AHG**
H_2O	-	0.153	0.178	< LOD	0.246	< LOD
EtOH	-	0.070	0.143	< LOD	0.167	< LOD
toluene	-	< LOD[b]	< LOD	< LOD	< LOD	< LOD
DCM	-	< LOD	< LOD	< LOD	< LOD	< LOD
THF	-	0.046	0.035	< LOD	0.211	< LOD
MeCN	-	< LOD	0.033	< LOD	0.113	< LOD
DMSO	-	7.780	0.169	0.002	0.179	< LOD

[a] Conditions: 5 M^{n+}-AHG beads were matured in a solvent (2 mL) at room temperature for 48 h. After this time the supernatant solution was filtrated and submitted for ICP-OES analysis. [b] LOD = 0.1 mg/L.

5. Kinetic study

Table S7. Kinetic study: Correlation between time and yield of the Ca^{2+}-AHG-catalyzed Henry reaction.[a]



1 **2** **3a**

Entry	time (h)	Yield (%)[b]
1	0	0
2	1	9
3	2	15
4	3	21
5	4	29
6	6	41
7	8	48
8	17.5	75
9	20	78
10	24	88

[a] Reaction conditions: 4-nitrobenzaldehyde (0.1 mmol), nitromethane (1.0 mmol), 1 unit of Ca^{2+}-AHG bead, DMSO (0.5 mL), room temperature; [b] Determined by ^{1}H NMR analysis of the crude product.

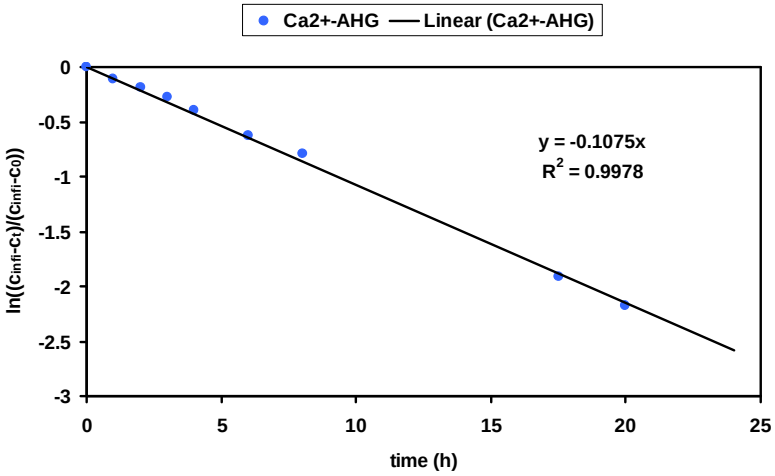


Figure S1. Kinetic analysis of the Ca^{2+}-AHG-catalyzed Henry reaction: k = 0.107 h^{-1}, R^2 = 0.9978.

6. IR spectra

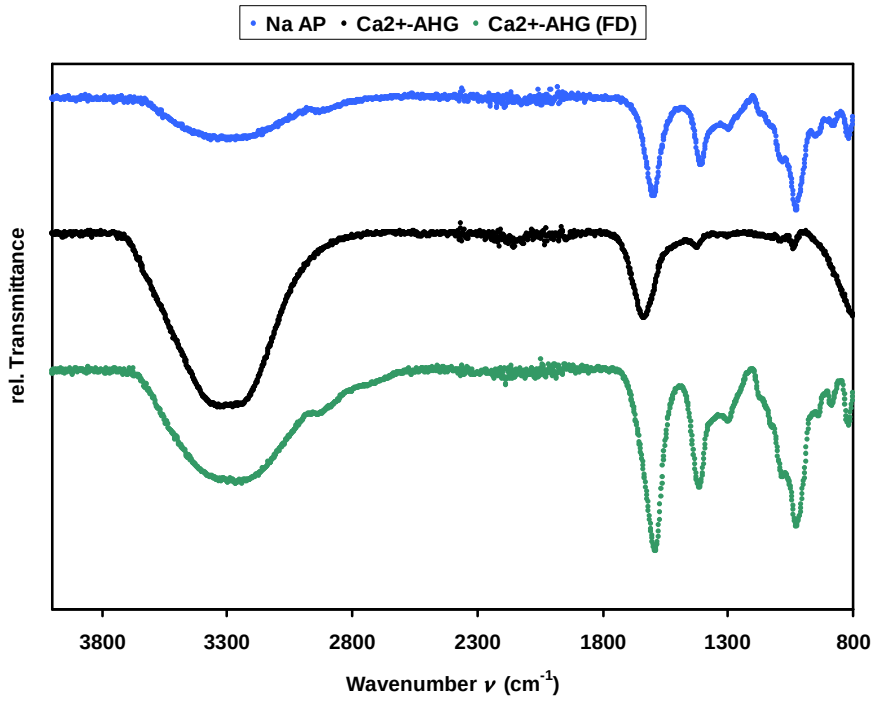


Figure S2. Comparison of the IR spectra: Na^{+}-AP (blue line), Ca^{2+}-AHG (black line) and freeze dried (FD) Ca^{2+}-AHG (green line).

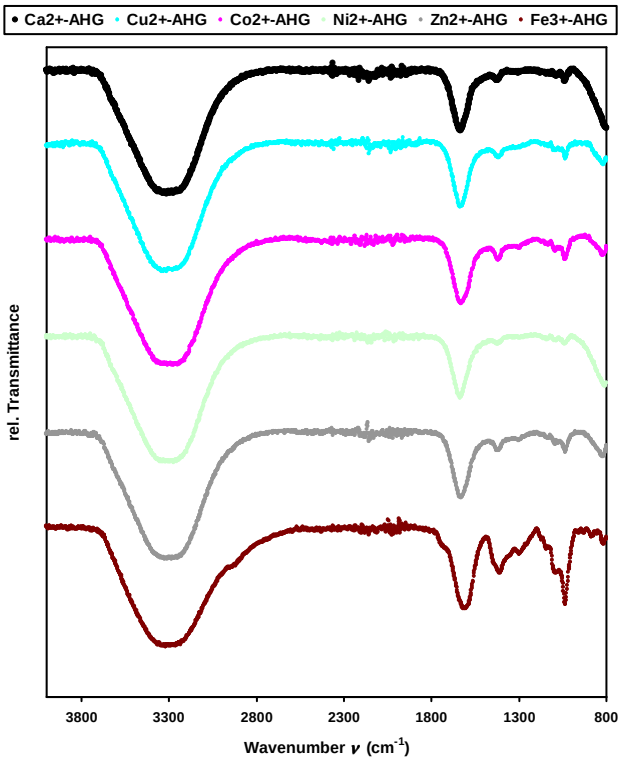


Figure S3. Comparison of M^{n+}-AHG IR spectra: Ca^{2+}-AHG (black line), Cu^{2+}-AHG (turquoise line), Co^{2+}-AHG (pink line), Ni^{2+}-AHG (green line), Zn^{2+}-AHG (grey line) and Fe^{3+}-AHG (brown line).

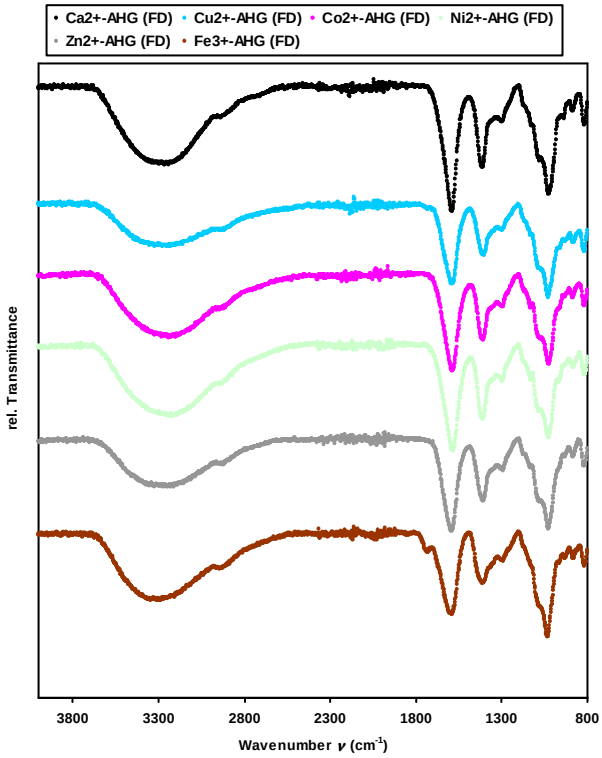


Figure S4. Comparison of freeze dried (FD) M^{n+}-AHG IR spectra: Ca^{2+}-AHG (FD) (black line), Cu^{2+}-AHG (FD) (turquoise line), Co^{2+}-AHG (FD) (pink line), Ni^{2+}-AHG (FD) (green line), Zn^{2+}-AHG (FD) (grey line) and Fe^{3+}-AHG (FD) (brown line).

7. TGA curves

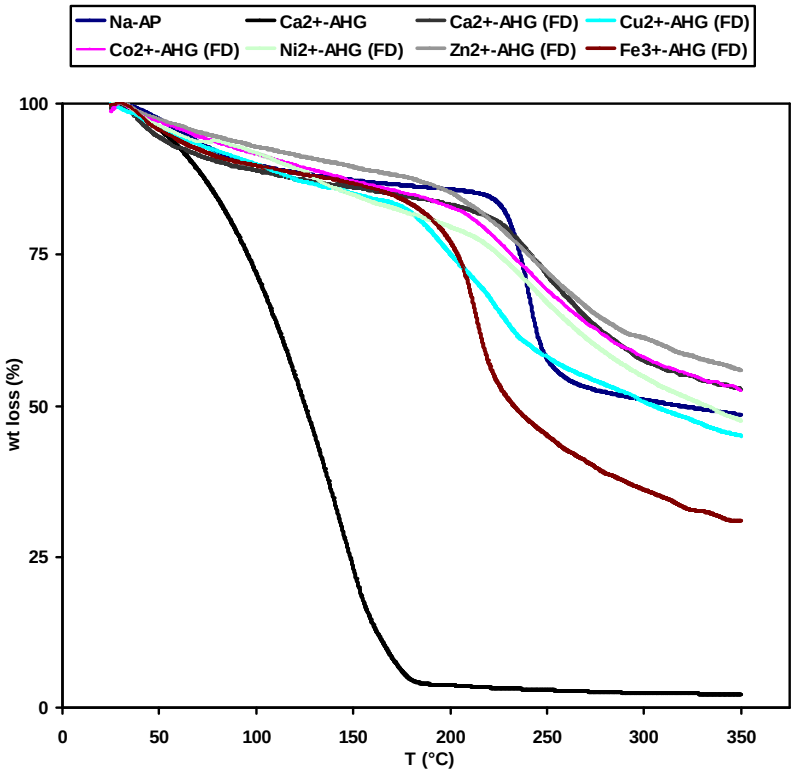


Figure S5. TGA curves of M^{n+}-AHG: Na^{+}-AP (blue line), Ca^{2+}-AHG (black line), freeze dried (FD) Ca^{2+}-AHG (black line), Cu^{2+}-AHG (FD) (turquoise line), Co^{2+}-AHG (FD) (pink line), Ni^{2+}-AHG (FD) (green line), Zn^{2+}-AHG (FD) (grey line) and Fe^{3+}-AHG (FD) (brown line).

8. Selected ^{1}H NMR spectra

Table 3, entry 1:[2] Diphenylmethane was used as internal standard (IS)

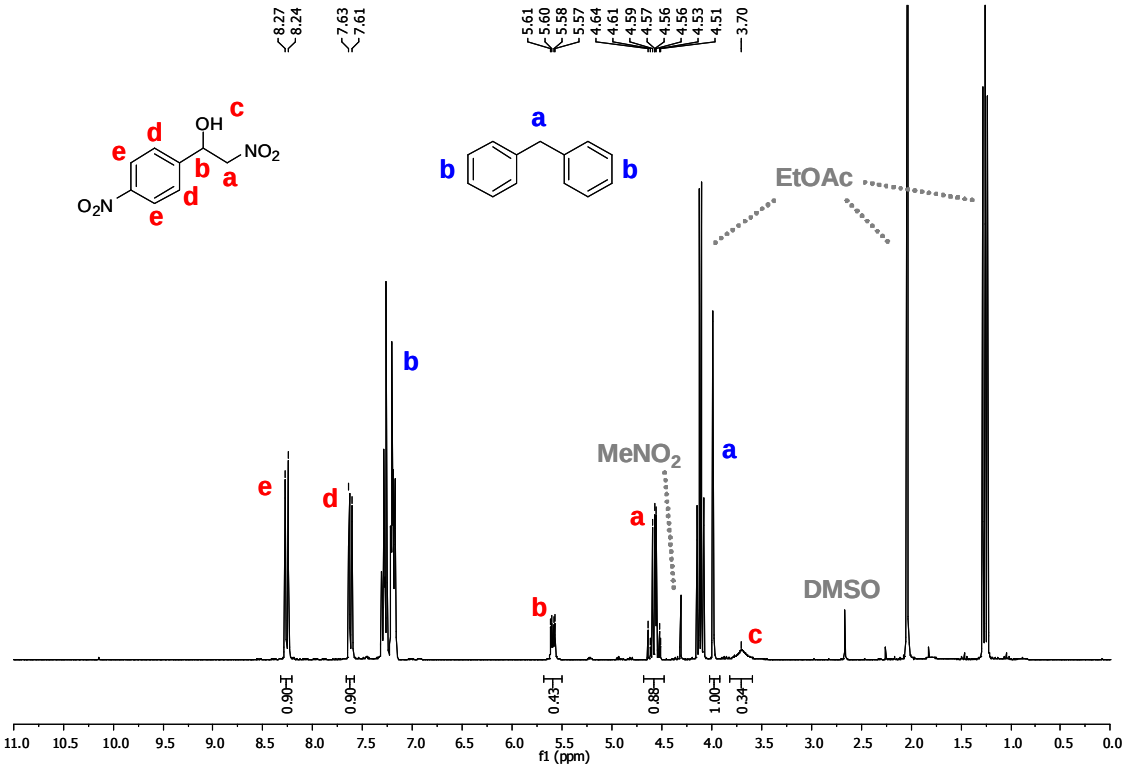


Table 3, entry 2:[3] Diphenylmethane was used as IS

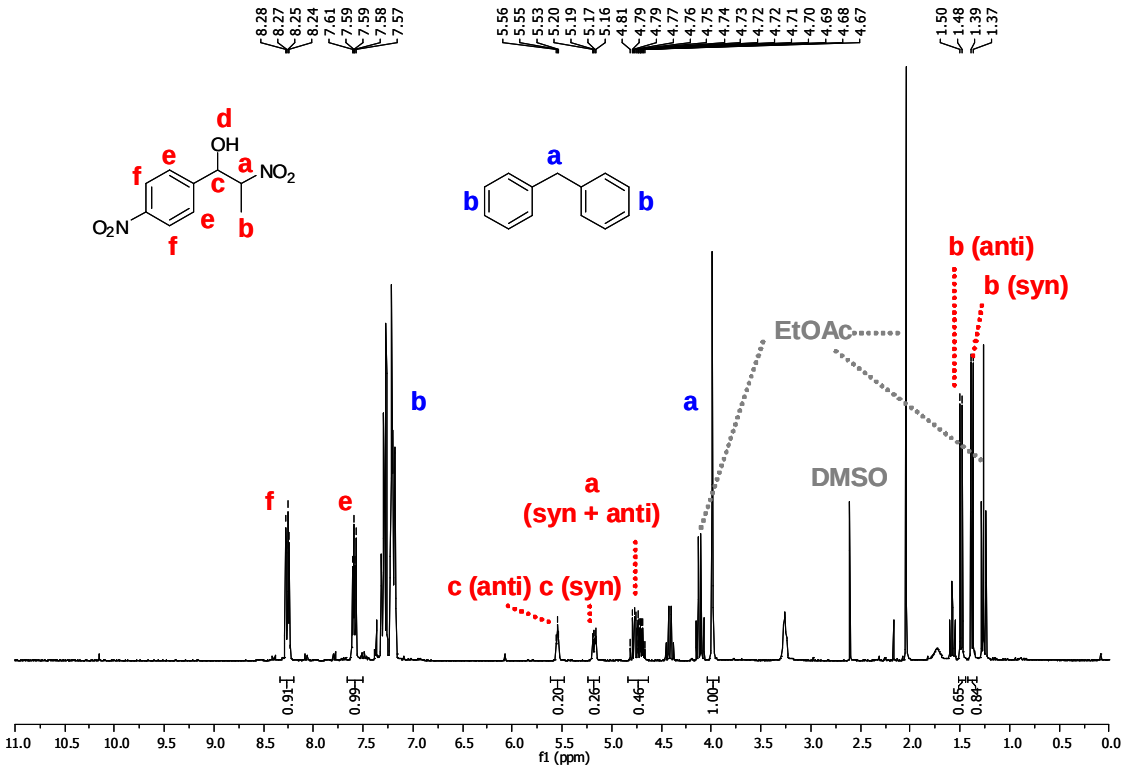


Table 3, entry 3:[2] Diphenylmethane was used as IS

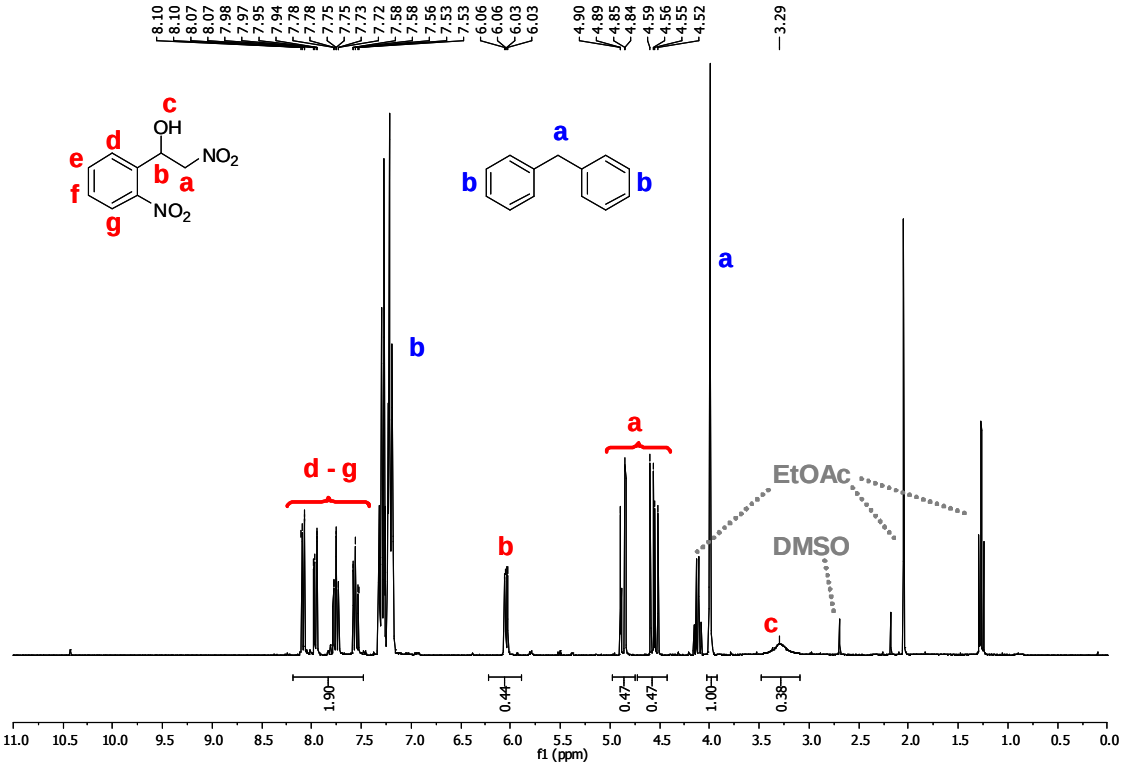


Table 3, entry 5:[3] *N,N*-Dimethylacetamide was used as IS

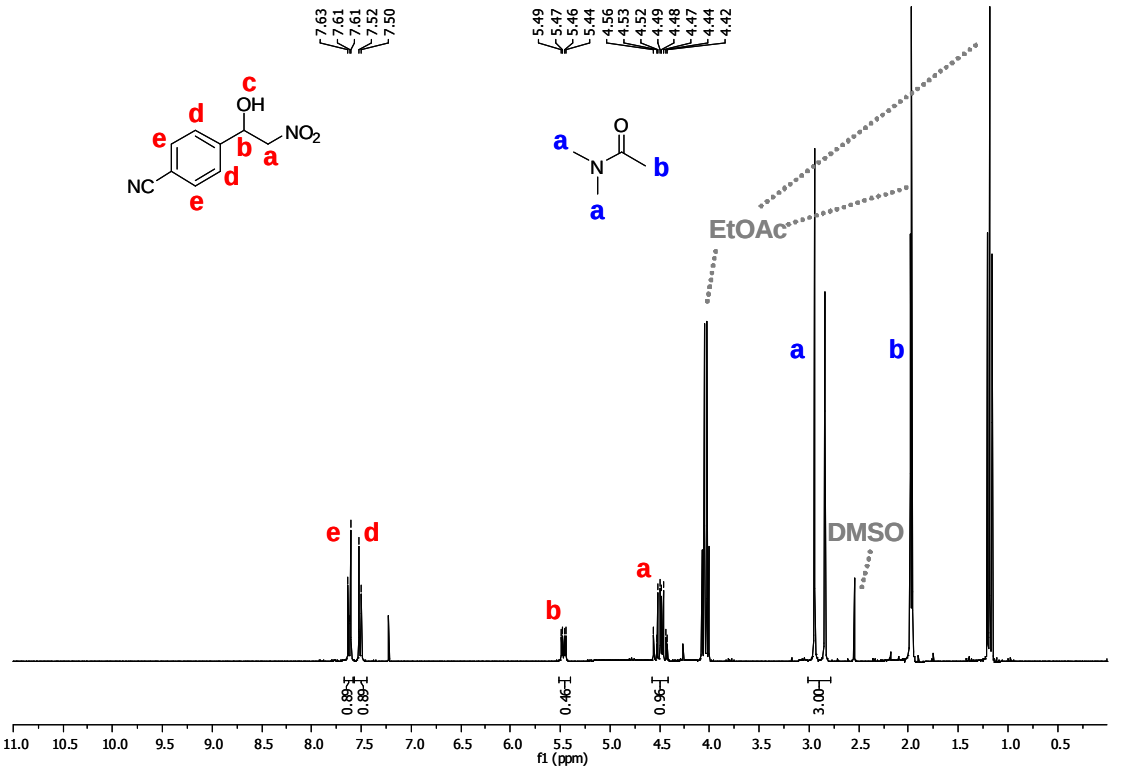


Table 3, entry 6:[4] Diphenylmethane was used as IS

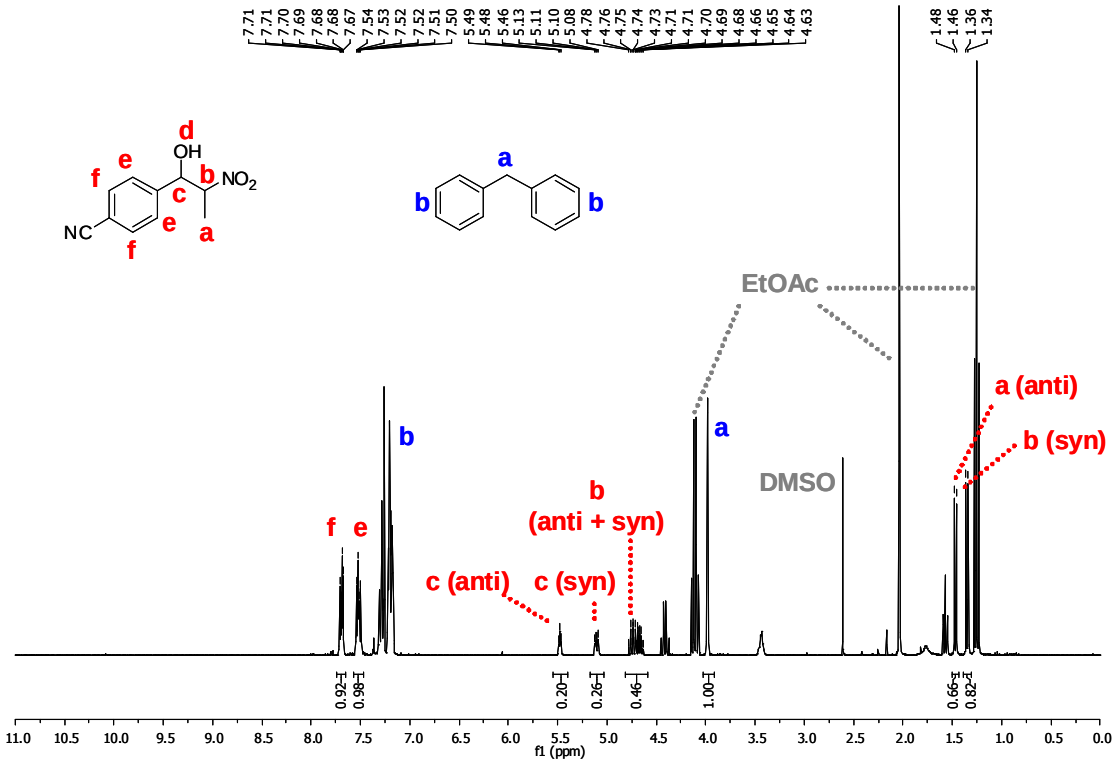


Table 3, entry 7:[5] *N,N*-Dimethylacetamide was used as IS

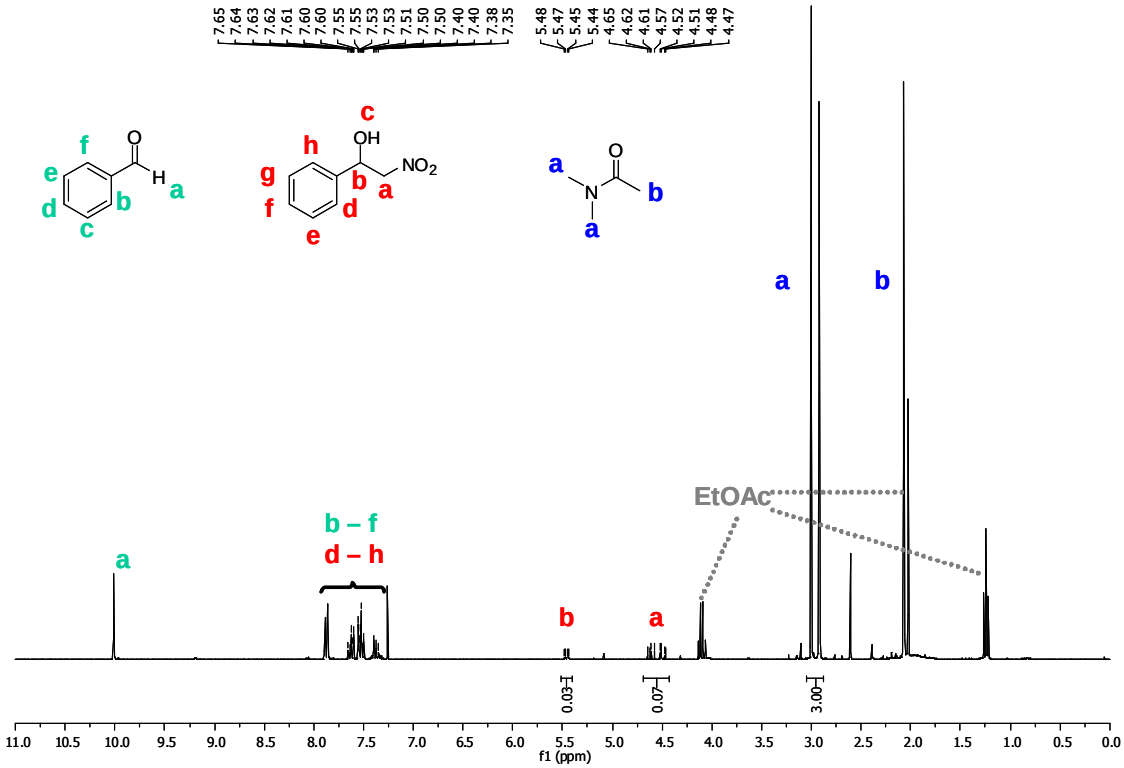


Table 3, entry 8:[3] *N,N*-Dimethylacetamide was used as IS

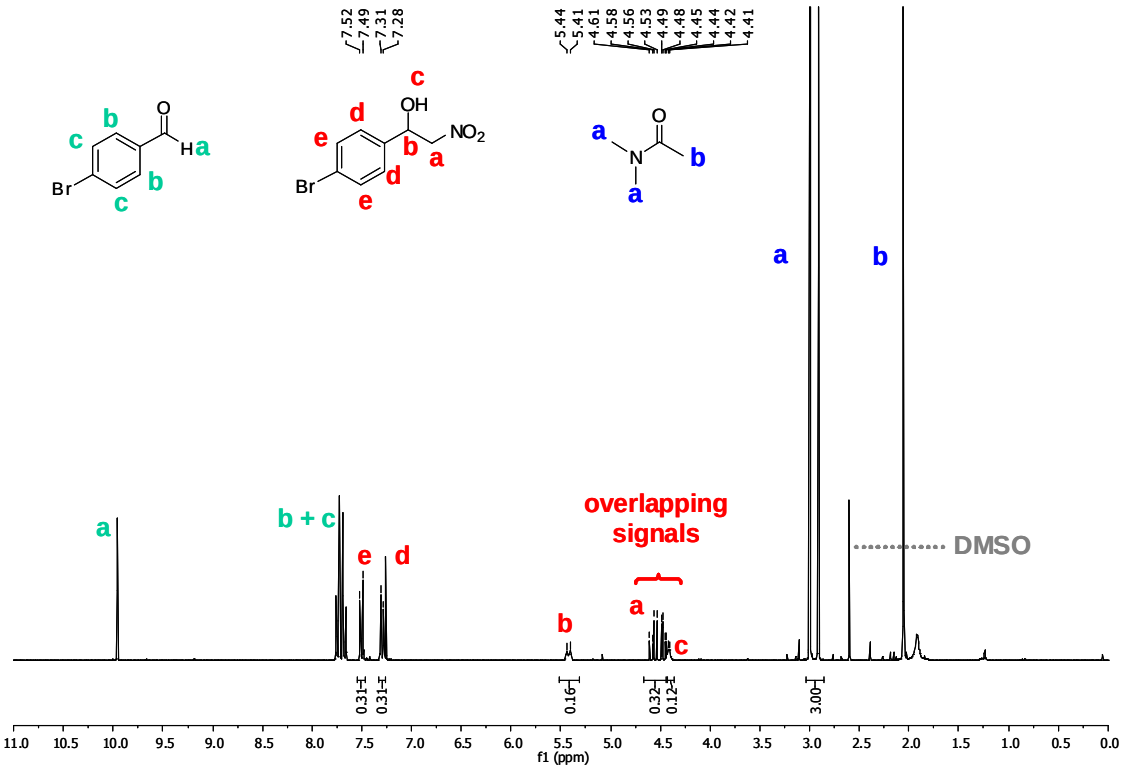


Table 3, entry 9:[5] *N,N*-Dimethylacetamide was used as IS

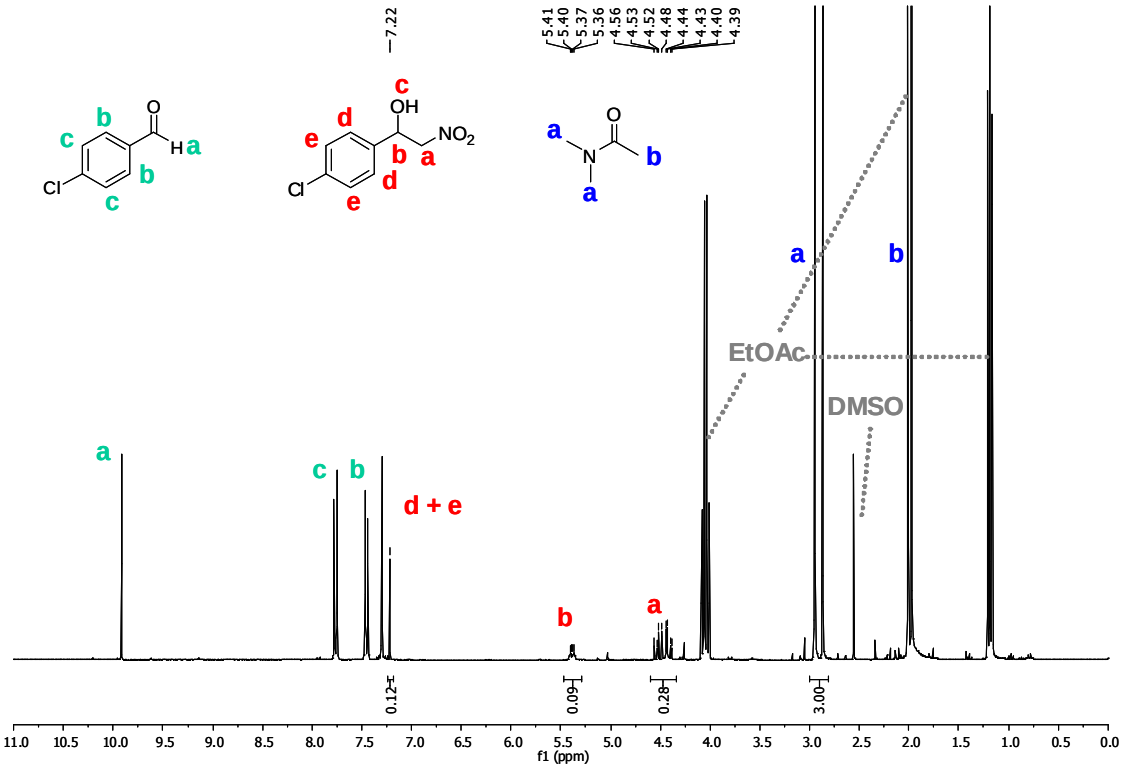


Table 3, entry 10:[5] Diphenylmethane was used as IS

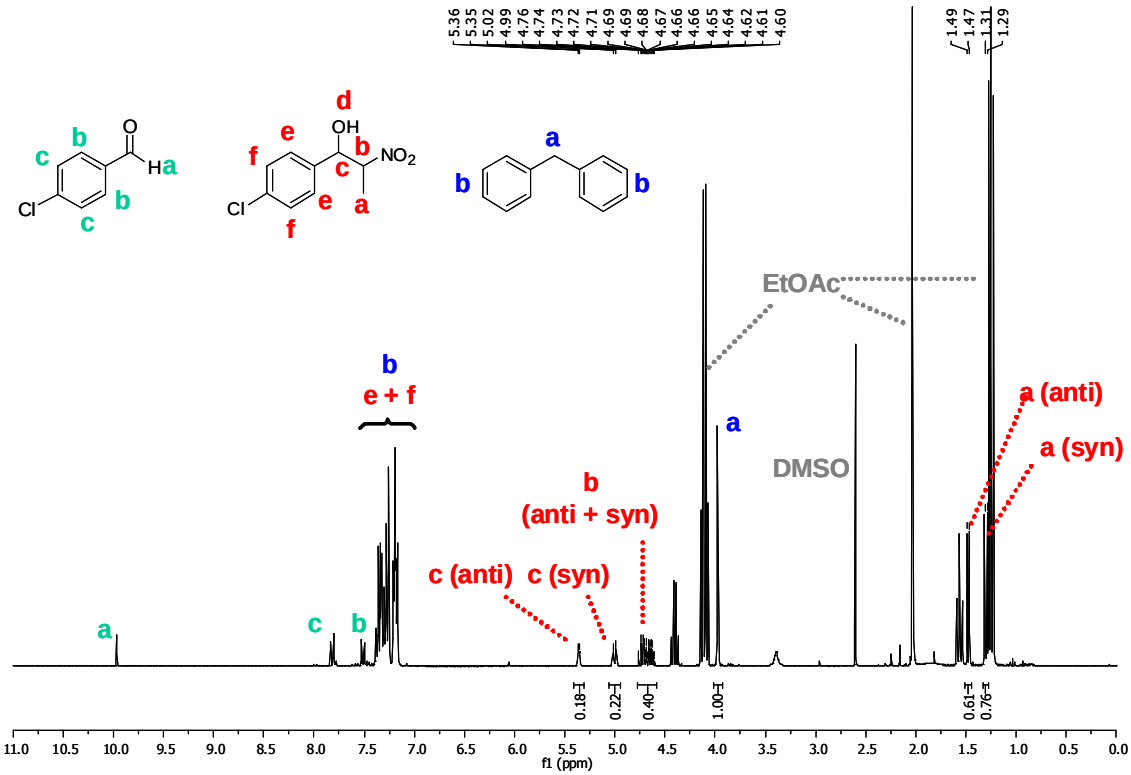
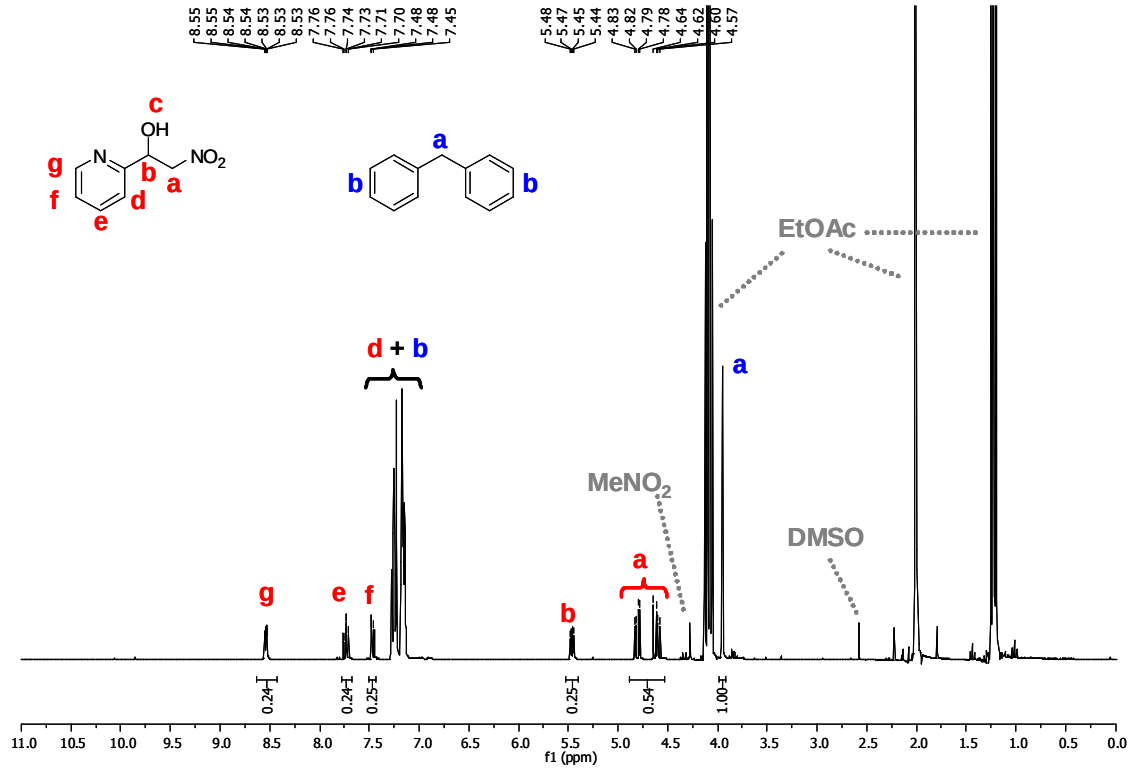
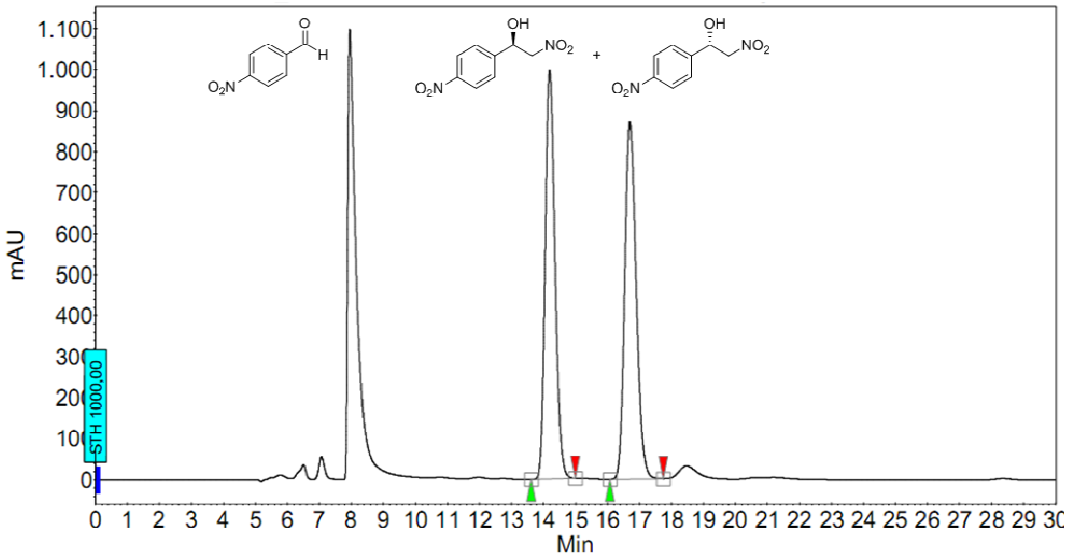


Table 3, entry 12:[3] Diphenylmethane was used as IS



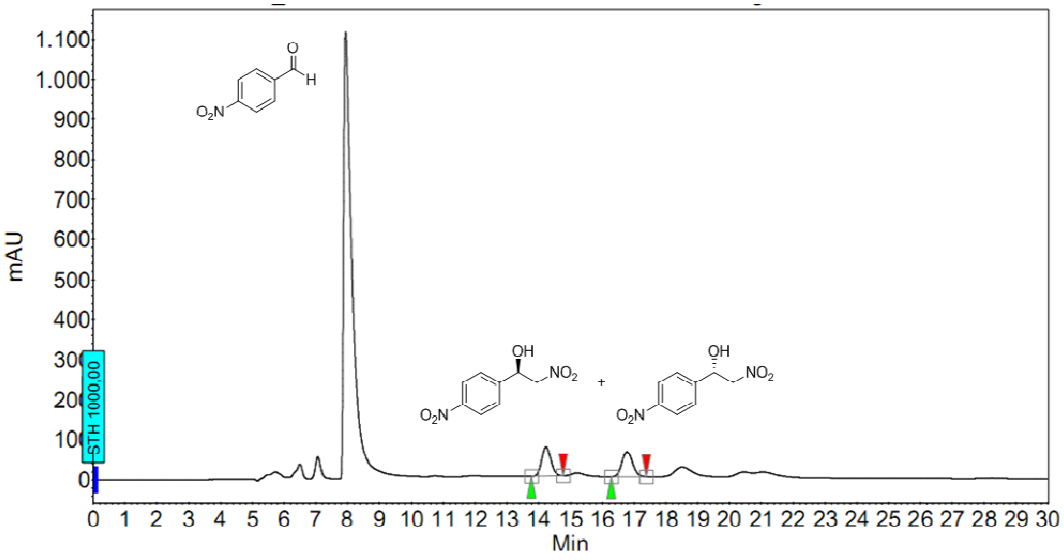
9. HPLC spectra

Ca^{2+}-AHG:



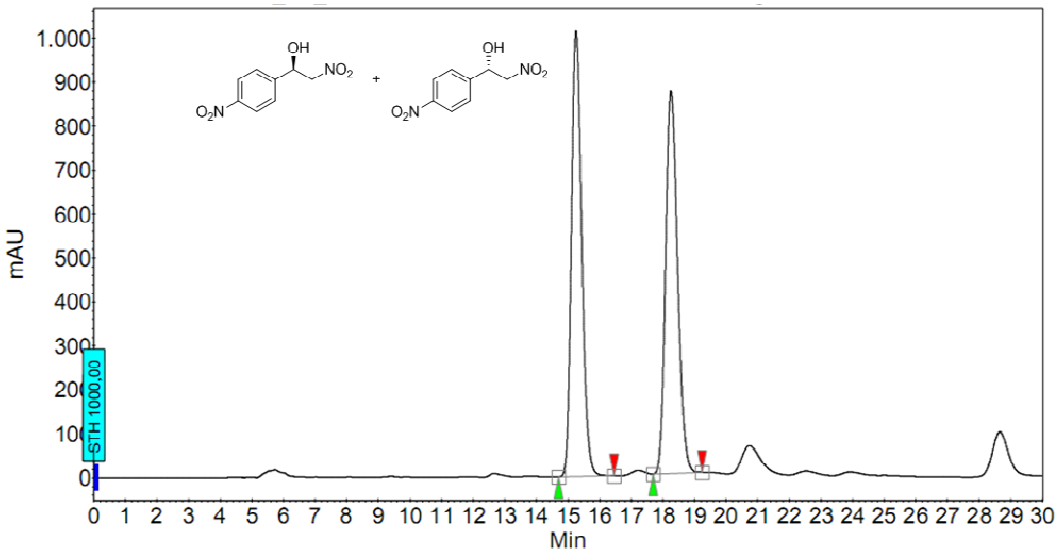
Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU.Min]	Area % [%]
1	UNKNOWN	14,19	49,61	995,7	353,1	49,606
2	UNKNOWN	16,70	50,39	869,2	358,7	50,394
Total			100,00	1864,9	711,9	100,000

Cu^{2+}-AHG:



Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU.Min]	Area % [%]
1	UNKNOWN	14,23	50,14	73,2	24,6	50,136
2	UNKNOWN	16,78	49,86	62,9	24,5	49,864
Total			100,00	136,2	49,0	100,000

Co^{2+}-AHG:



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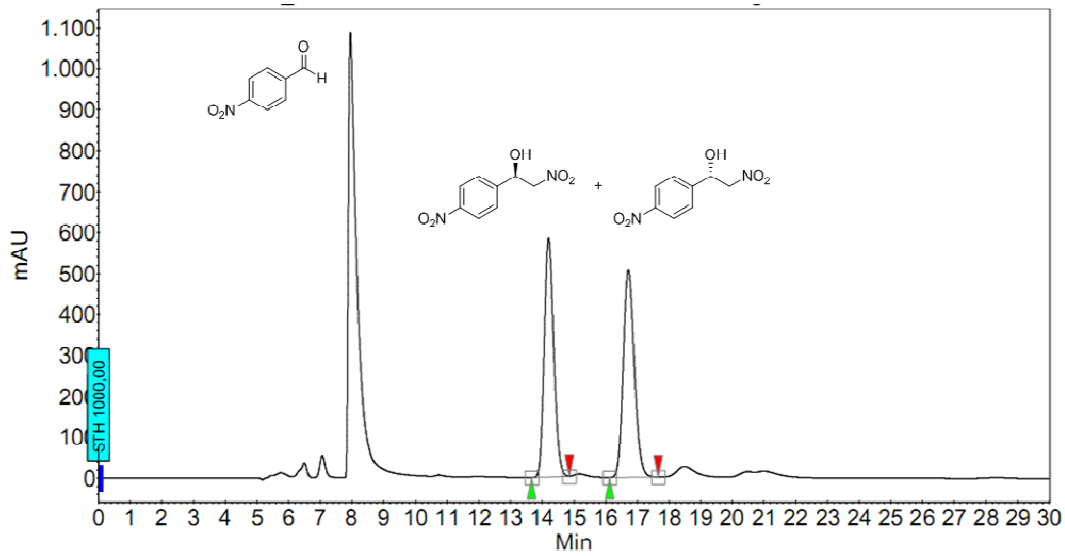
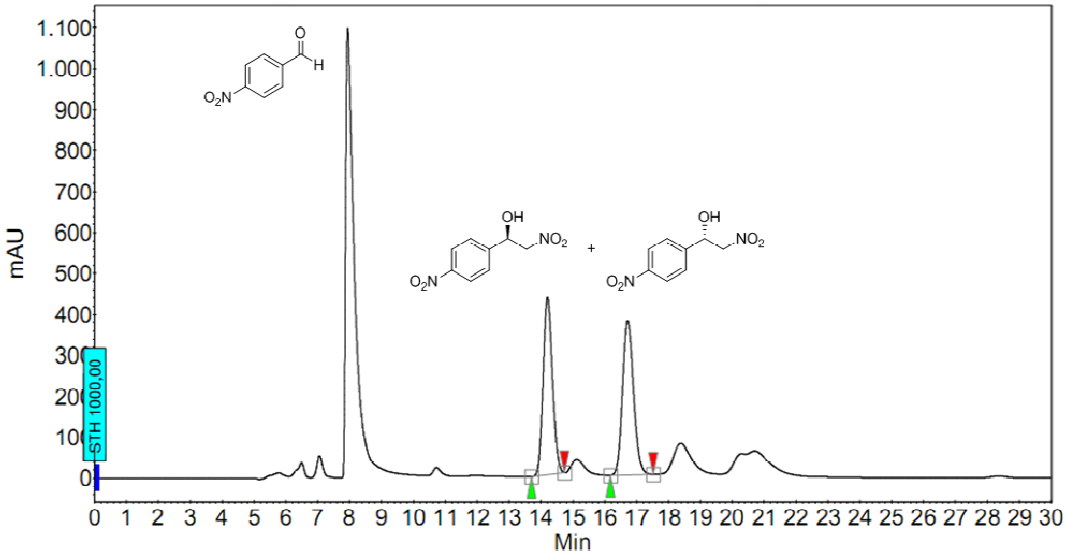
1	UNKNOWN	15,25	49,94	1012,5	381,7	49,937
2	UNKNOWN	18,25	50,06	870,2	382,6	50,063
Total			100,00	1882,7	764,3	100,000

Ni^{2+}-AHG:



Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU.Min]	Area % [%]
1	UNKNOWN	14,20	49,69	583,6	202,1	49,692
2	UNKNOWN	16,72	50,31	506,8	204,6	50,308
Total			100,00	1090,4	406,7	100,000

Zn^{2+}-AHG:



Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU.Min]	Area % [%]
1	UNKNOWN	14,20	49,56	433,1	147,4	49,556
2	UNKNOWN	16,72	50,44	376,5	150,0	50,444
Total			100,00	809,6	297,4	100,000

10. References

[1] Y. Dong, W. Dong, Y. Cao, Z. Han, Z. Ding, *Catal. Today* **2011**, *175*, 346-355.

[2] D. A. Evans, D. Seidel, M. Rueping, H. W. Lam, J. T. Shaw, C. W. Downey, *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

[3] E. Busto, V. Gotor-Fernández, V. Gotor, *Org. Process Res. Dev.* **2011**, *15*, 236-240.

[4] a) for *syn* isomer: C. Liang, D. Jiaxing, Y. Jingsong, G. Ge, L. Jingbo, *Chem. Eur. J.* **2010**, *16*, 6761-6765; b) for *anti* isomer: T. Nitabaru, A. Nojiri, M. Kobayashi, N. Kumagai, M. Shibasaki, *J. Am. Chem. Soc.* **2009**, *131*, 13860-13869.

[5] Y. Qiong ji, G. Qi, Z. M. A. Judeh, *Eur. J. Org. Chem.* **2011**, 4892-4898.