

Accessory Publication

# **Hydrogenation of glucose over Ru nanoparticles embedded in templated porous carbon**

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## Context

1. Preliminary consideration
2. HPLC results

## 1. Preliminary consideration

The liquid-phase hydrogenation of glucose was performed at 80bar of H<sub>2</sub> pressure and 100 °C in a Parr batch reactor (300 mL). About 0.05 g of a solid catalyst and 30 mL of 40 wt% glucose solution were placed in the reactor. Prior to the first hydrogenation batch, we use the Ru6C3 catalyst to do the preliminary reaction. Fig. 1 gives the glucose concentration and sorbitol concentration as a function of hydrogenation time. It can be seen from the Fig.1 that after 3 hrs the rate of the glucose consumption becomes slow, so we set the reaction time as 3 hr for all the catalysts to compare the performance of all catalysts. The mean catalytic activity of a catalyst was calculated as the yield of moles of sorbitol per mole of Ru per second. HPLC analysis data showed that sorbitol was the only product when Ru-carbon nanostructured catalysts were used as the catalysts, so the selectivity is 100%. Therefore, we use the mean catalytic activity, which was calculated as the yield of moles of sorbitol per mole of Ru per second, to compare the performance of all the catalysts.

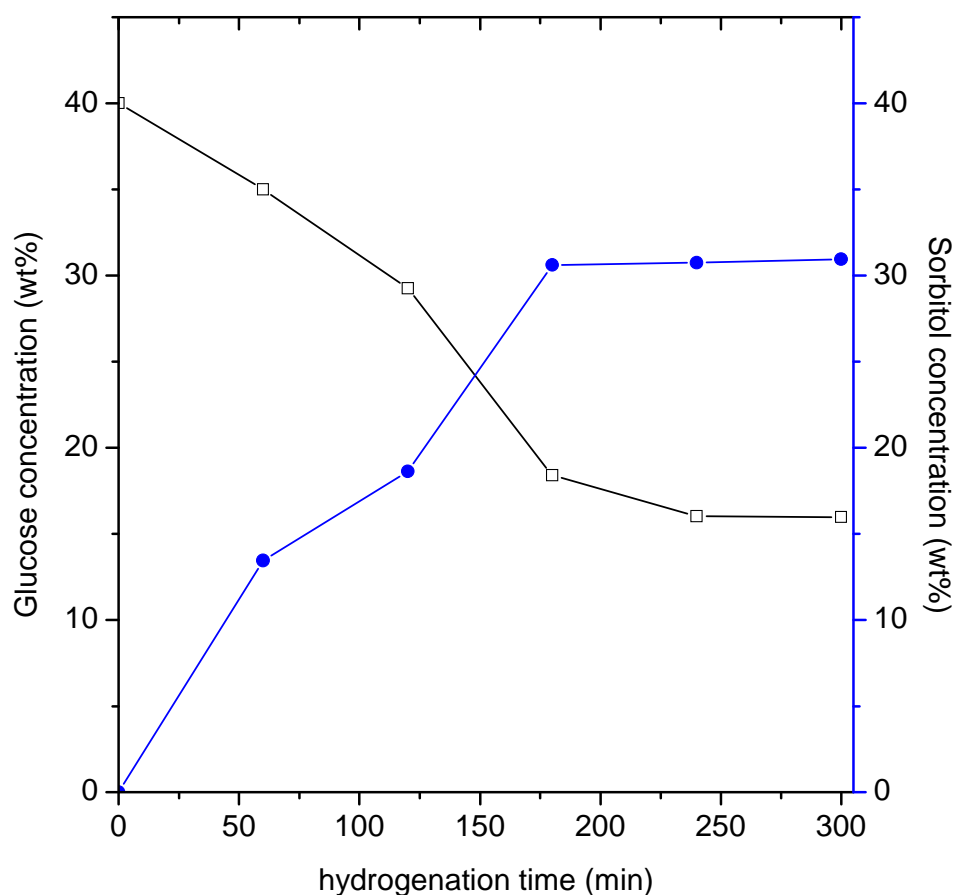


Fig. S1. Typical concentration profile of the hydrogenation of glucose to sorbitol (Ru6C3, 80bar, 100 °C, 40wt% glucose).

## 2. HPLC results

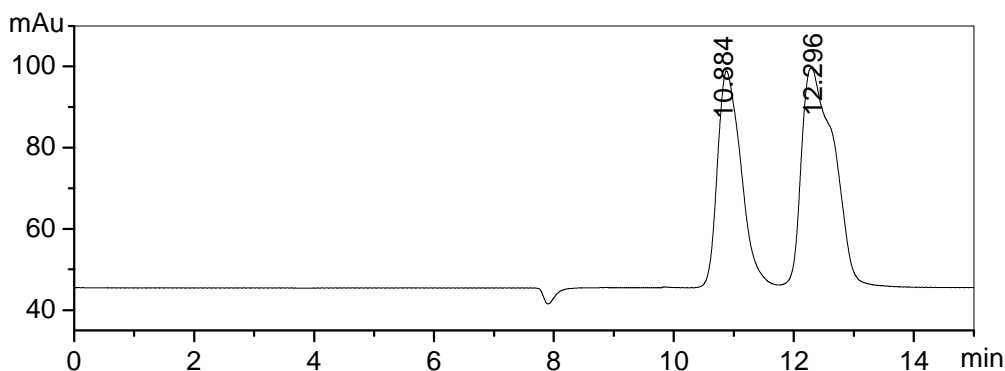
Ru6C(HY)-3

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample11.D Sample Name: R1

LC\_VWD 5/8/2007 4:19:05 PM LJJ

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Injection Date   : 5/8/2007 4:03:58 PM      Seq. Line : 11
Sample Name     : R1                       Location  : Vial 11
Acq. Operator  : LJJ                       Inj       : 1
                                           Inj Volume: 20 µl
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Sequence File   : C:\HPCHEM\1\SEQUENCE\LJJ.S
Method          : C:\HPCHEM\2\METHODS\LJJ.M
Last changed    : 5/8/2007 4:02:17 PM by LJJ
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### Area Percent Report

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Sorted By       : Signal
Multiplier      : 1.0000
Dilution        : 1.0000
Use Multiplier & Dilution Factor with ISTDs
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Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.884	VV	0.4473	1495.18298	53.29897	41.9985
2	12.296	VV	0.5328	2064.90161	54.15576	58.0015
Totals :				3560.08459	107.45473	

\*\*\* End of Report \*\*\*

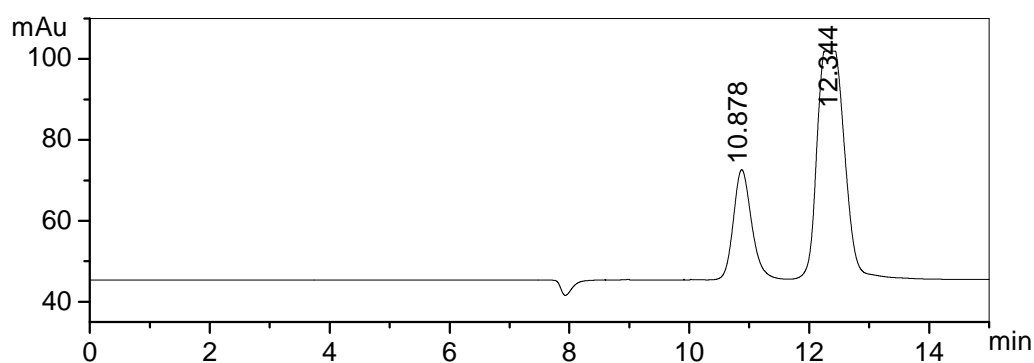
Ru6C3

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample12.D Sample Name: R2

LC\_VWD 5/8/2007 4:35:59 PM LJJ

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Injection Date : 5/8/2007 4:32:11 PM      Seq. Line : 12  
Sample Name : R2                              Location : Vial 12  
Acq. Operator : LJJ                            Inj : 1  
    Inj Volume : 20 µl

Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
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Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.878	VV	0.3322	591.47998	27.36126	24.2333
2	12.344	VB	0.5249	1849.28894	56.64146	75.7667
Totals :				2440.76892	84.00272	

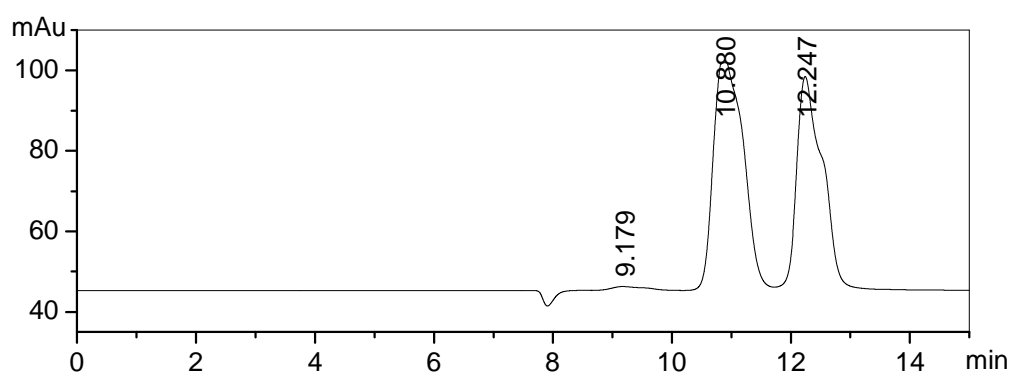
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Ru/C-SBA15-H

Data File C:\HPCHEM\2\DATA\LJJ071110\Sample13.D Sample Name: R3

LC\_VWD 5/8/2007 4:52:53 PM LJJ

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Injection Date : 5/8/2007 4:50:08 PM      Seq. Line : 13  
Sample Name : R3                              Location : Vial 13  
Acq. Operator : LJJ                              Inj : 1  
    Inj Volume : 20 µl  
Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
Method : C:\HPCHEM\2\METHODS\LJJ.M  
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Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.179	PV	0.1963	9.55244	1.11117	0.2616
2	10.880	VV	0.5174	2012.20752	56.78840	55.1009
3	12.247	VV	0.4388	1630.09949	53.01098	44.6375
Totals :				3651.85944	110.91056	

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\*\*\* End of Report \*\*\*

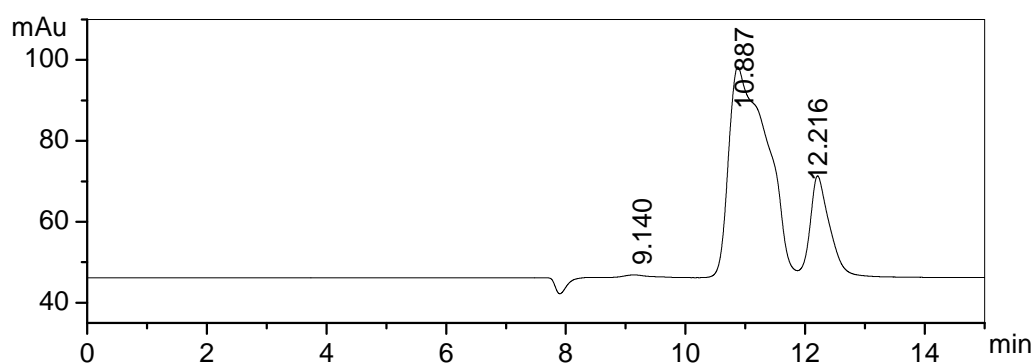
Ru/C-HY-H

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample14.D Sample Name: R4

LC\_VWD 5/8/2007 5:09:48 PM LJJ

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Sample Name : R4                              Location : Vial 14  
Acq. Operator : LJJ                            Inj : 1  
   Inj Volume : 20 µl

Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
Method : C:\HPCHEM\2\METHODS\LJJ.M  
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Area Percent Report  
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Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.140	VV	0.5905	37.21112	8.63880e-1	1.2621
2	10.887	VV	0.5933	2318.95532	51.89729	78.6502
3	12.216	VB	0.3408	592.27545	24.96094	20.0877
Totals :				2948.44189	77.72211	

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\*\*\* End of Report \*\*\*  
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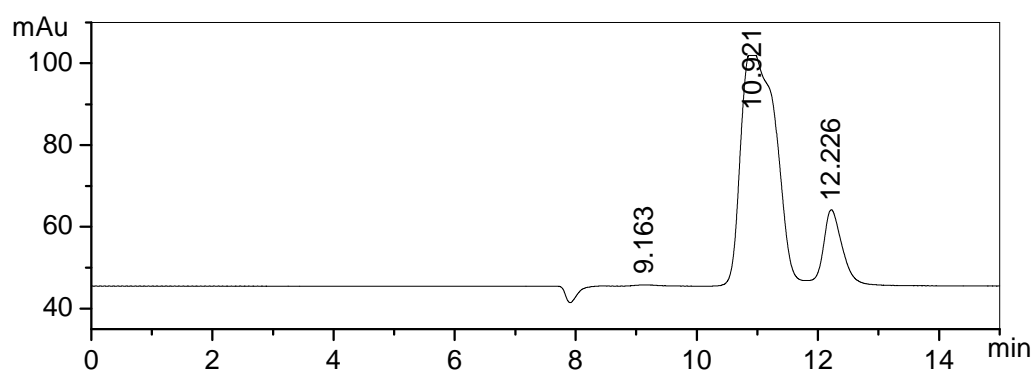
Ru/HY-H

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample15.D Sample Name: R5

LC\_VWD 5/8/2007 5:26:43 PM LJJ

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Injection Date : 5/8/2007 5:26:02 PM      Seq. Line : 15  
Sample Name : R5                              Location : Vial 15  
Acq. Operator : LJJ                           Inj : 1  
   Inj Volume : 20 µl

Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
Method : C:\HPCHEM\2\METHODS\LJJ.M  
Last changed : 5/8/2007 5:09:51 PM by LJJ  
(modified after loading)



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Area Percent Report  
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Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.163	VV	0.4674	10.28337	3.09712e-1	0.3786
2	10.921	VV	0.5665	2277.30469	56.47033	83.8333
3	12.226	VV	0.3395	428.88065	18.70171	15.7882
Totals :				2716.46870	75.48175	

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\*\*\* End of Report \*\*\*

Ru/SBA15-H

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample16.D Sample Name: R6

LC\_VWD 5/8/2007 5:43:38 PM LJJ

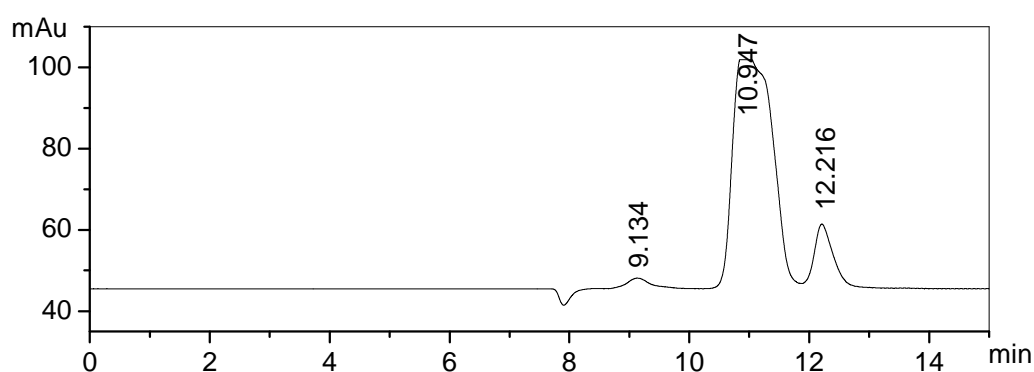
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Sample Name : R6      Location : Vial 16  
Acq. Operator : LJJ      Inj : 1  
Inj Volume : 20 µl

Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S

Method : C:\HPCHEM\2\METHODS\LJJ.M

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### Area Percent Report

Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.134	PV	0.8505	280.92752	4.29854	8.1616
2	10.947	VV	0.6745	2697.53613	57.58691	78.3699
3	12.216	VV	0.4052	463.59164	16.63283	13.4685
Totals :				3442.05530	78.51827	

\*\*\* End of Report \*\*\*



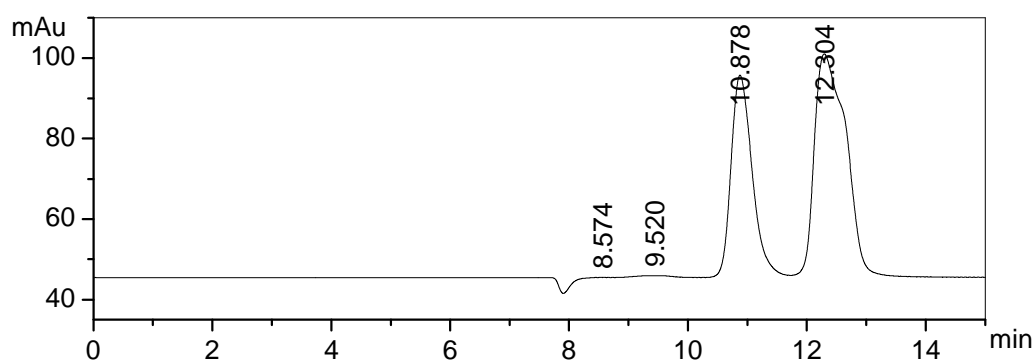
Ru/C

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample17.D Sample Name: R7

LC\_VWD 5/8/2007 6:00:35 PM LJJ

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Injection Date : 5/8/2007 6:02:01 PM      Seq. Line : 17  
Sample Name : R7                              Location : Vial 17  
Acq. Operator : LJJ                            Inj : 1  
   Inj Volume : 20 µl

Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
Method : C:\HPCHEM\2\METHODS\LJJ.M  
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Area Percent Report

Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs  
Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.574	PV	0.3968	55.45488	1.89822	1.4852
2	9.520	VV	1.0000	165.93427	2.06822	4.4441
3	10.878	VV	0.4117	1357.62793	51.47097	36.3601
4	12.304	VV	0.5428	2154.82666	56.25971	57.7107
Totals :				3733.84373	111.69712	

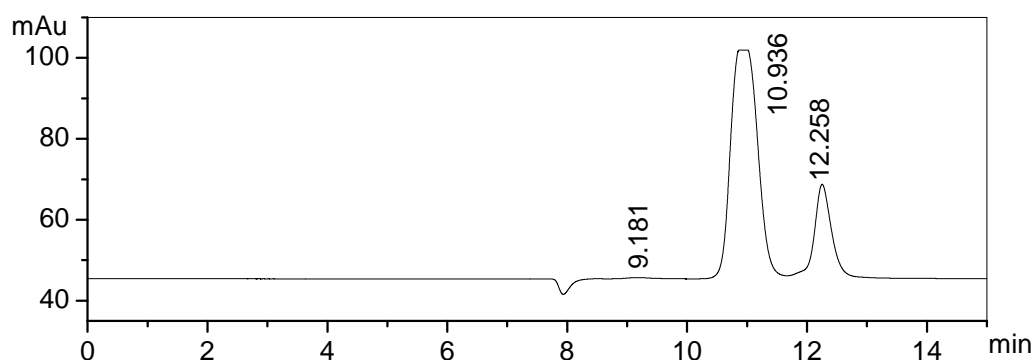
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Ni65

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample18.D Sample Name: R8

LC\_VWD 5/8/2007 6:17:33 PM LJJ

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Injection Date : 5/8/2007 6:19:57 PM      Seq. Line : 18  
Sample Name : R8                              Location : Vial 18  
Acq. Operator : LJJ                            Inj : 1  
   Inj Volume : 20 µl  
Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
Method : C:\HPCHEM\2\METHODS\LJJ.M  
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Area Percent Report

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Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.181	VP	0.4523	9.48475	3.17729e-1	0.4169
2	10.936	VV	0.5024	1775.25232	56.52843	78.0221
3	12.258	VB	0.3176	490.58316	23.30387	21.5611
Totals :				2275.32023	80.15003	

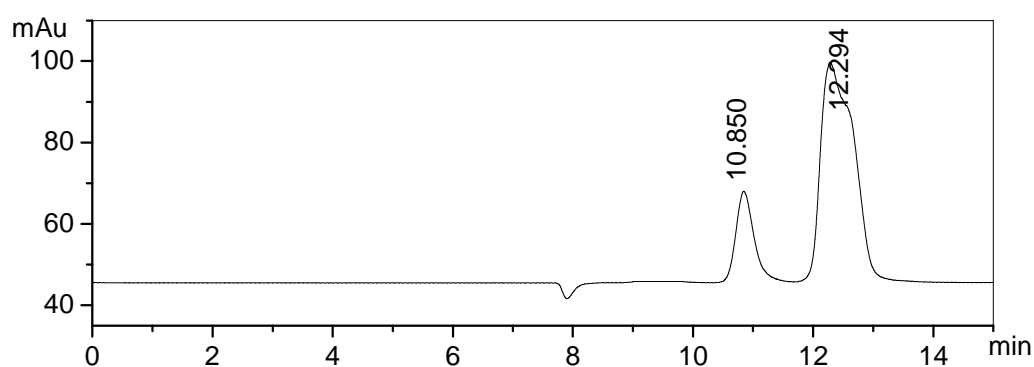
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Ru8C3

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample13.D Sample Name: R1

LC\_VWD 5/26/2007 4:20:42 PM LJJ

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Injection Date : 5/26/2007 4:17:58 PM      Seq. Line : 13  
Sample Name : R1                              Location : Vial 13  
Acq. Operator : LJJ                            Inj : 1  
    Inj Volume : 20 µl  
Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
Method : C:\HPCHEM\2\METHODS\LJJ.M  
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Area Percent Report  
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Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.850	VV	0.3361	495.98666	22.59471	19.1536
2	12.294	VV	0.5380	2093.53662	54.27150	80.8464
Totals :				2589.52328	76.86621	

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\*\*\* End of Report \*\*\*  
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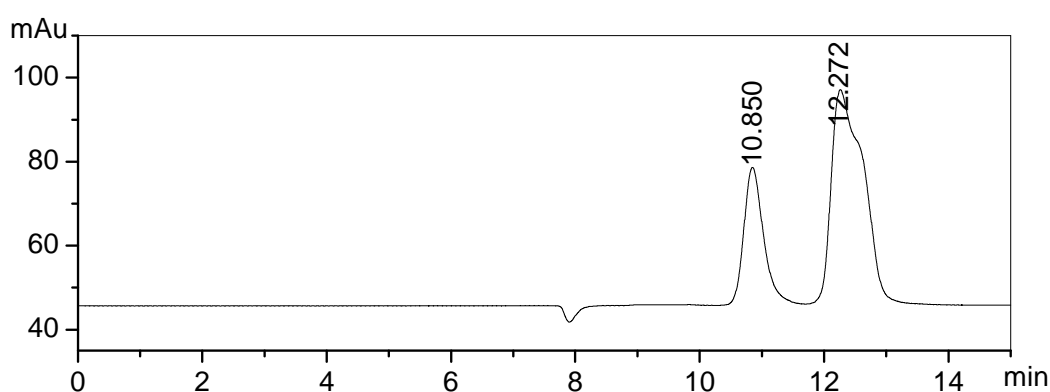
Ru12C3

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample14.D Sample Name: R2

LC\_VWD 5/26/2007 4:37:36 PM LJJ

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Injection Date : 5/26/2007 4:35:55 PM      Seq. Line : 14  
Sample Name : R2                              Location : Vial 14  
Acq. Operator : LJJ                            Inj : 1  
   Inj Volume : 20 µl

Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
Method : C:\HPCHEM\2\METHODS\LJJ.M  
Last changed : 5/26/2007 4:20:46 PM by LJJ  
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Area Percent Report  
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Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.850	VV	0.3454	749.89270	32.96581	28.5287
2	12.272	VV	0.5081	1878.66382	51.20322	71.4713
Totals :				2628.55652	84.16903	

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\*\*\* End of Report \*\*\*

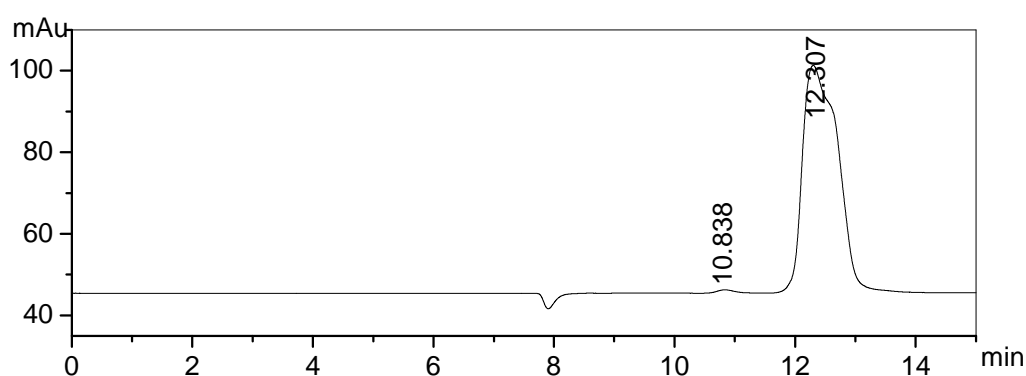
Ru8C2

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample15.D Sample Name: R3

LC\_VWD 5/26/2007 4:54:31 PM LJJ

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Injection Date : 5/26/2007 4:53:55 PM      Seq. Line : 15  
Sample Name : R3                                Location : Vial 15  
Acq. Operator : LJJ                             Inj : 1  
    Inj Volume : 20 µl

Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
Method : C:\HPCHEM\2\METHODS\LJJ.M  
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Area Percent Report

Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.838	VV	0.3484	41.98482	1.48849	1.8091
2	12.307	VV	0.5643	2278.74634	55.81200	98.1909
Totals :				2320.73116	57.30049	

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\*\*\* End of Report \*\*\*

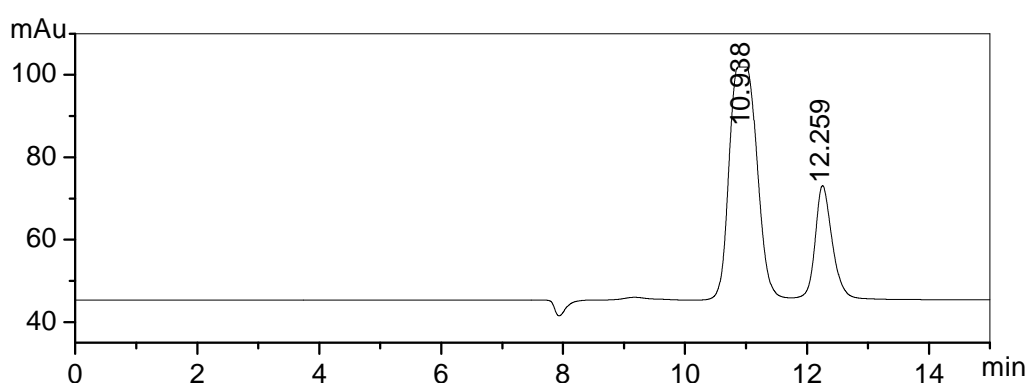
Ru8C4

Data File C:\HPCHEM\2\DATA\LJJ07110\Sample16.D Sample Name: R4

LC\_VWD 5/26/2007 5:11:26 PM LJJ

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Injection Date : 5/26/2007 5:11:52 PM      Seq. Line : 16  
Sample Name : R4                              Location : Vial 16  
Acq. Operator : LJJ                            Inj : 1  
   Inj Volume : 20 µl

Sequence File : C:\HPCHEM\1\SEQUENCE\LJJ.S  
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Area Percent Report  
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Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: ADC1 A, ADC1 CHANNEL A

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.938	VV	0.5049	1790.14685	56.61171	76.0120
2	12.259	VB	0.3097	564.93915	27.73139	23.9880
Totals :				2355.08600	84.34310	

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