Electronic Supplementary Information (ESI) for

Sodium Borohydride-Nickel Chloride Hexahydrate in EtOH/PEG-400 as an Efficient and Recyclable Catalytic System for the Reduction of Alkenes

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1. Materials and analyses

$NiCl_2 \cdot 6H_2O$, PEG-400 were purchased from Alfa Aesar. Alkenes and solvents were from Aladdin. Unless otherwise noted, all chemicals were analytical reagents without further purification. UV-vis measurement was acquired using a UV/Vis spectrophotometer. The HRTEM image was taken with a JEM2100F TEM at an accelerating voltage of 200 kV. XPS analysis was performed on a Thermo VG ESCALAB 250 Microprobe instrument using Al Kα radiation as the X-ray source. The binding energy of the element was calibrated using a C 1s photoelectron peak at 284.6 eV. ICP-AES analyses of Ni leaching were carried out on Optima 2000DV (Thermo Elemental, USA).GC analyses were performed on Persee GC1100 instrument equipped with a 50 m × 0.25 mm OV-101 column and a FID detector. GC-MS were acquired using Persee MT-80EI with a 50 m × 0.25 mm HP-5MS column (He as a carrier gas)

2 General procedures for the reduction of alkenes catalyzed by in situ generated Ni NPs

In a typical experiment, a solution of alkene (5 mmol) and $NiCl_2 \cdot 6H_2O$ (0.25 mmol) in the mixture of anhydrous ethanol and PEG-400 (5 mL, volume ratio 3:2) was added $NaBH_4$ (95 mg, 2.5 mmol) under N_2 atmosphere, the flask was immediately sealed and stirred at 30 ^oC for a certain time. After reaction, the result mixture was extracted with 5 mL *n*-heptane or

petroleum ether. The upper phase was separated by decantation and analyzed by GC and GC-MS.

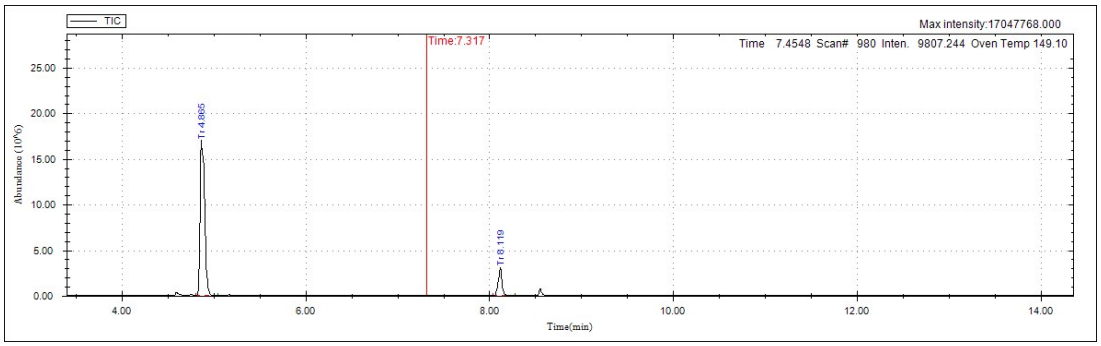
3 Procedure for the reduction of styrene catalyzed by preformd Ni NPs

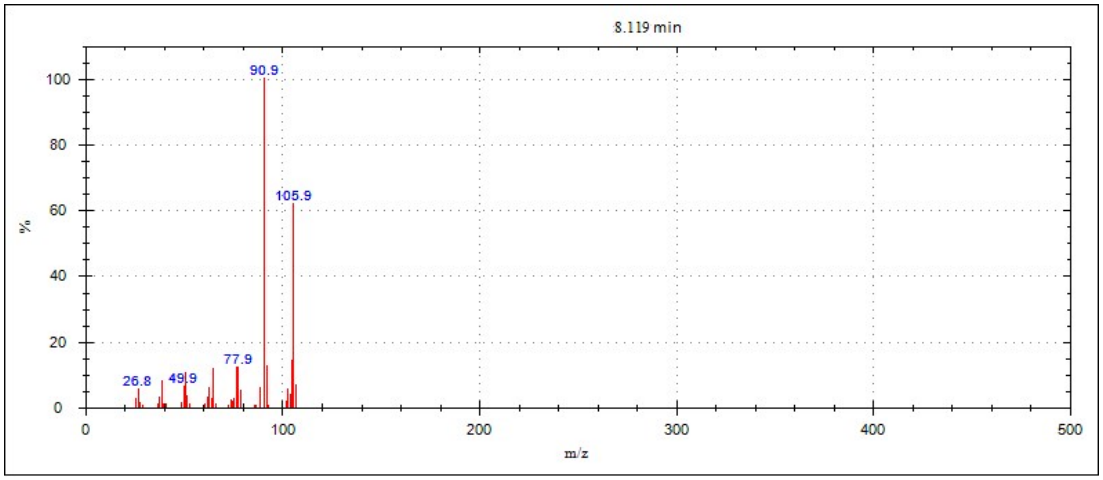
$NiCl_2 \cdot 6H_2O$ (0.25 mmol) was dissolved in the mixture of anhydrous ethanol and PEG-400 (5 mL， volume ratio 3:2) under N_2 atmosphere, $NaBH_4$ was added (10 mg, 0.26 mmol) and then the color of solution turned to black immediately, suggesting the formation of Ni nanoparticles. Styrene (5 mmol) and $NaBH_4$ (85 mg, 2.24 mmol) were added to the reaction mixture. The flask was immediately sealed and stirred at 30 °C for a certain time. After reaction, the result mixture was extracted with 5 mL *n*-heptane, and the yield of ethylbenzene was determined by GC and GC-MS analysis.

4 GC-MS data for hydrogenated products

Ethylbenzene(C_8H_{10}), t_r = 8.119 min

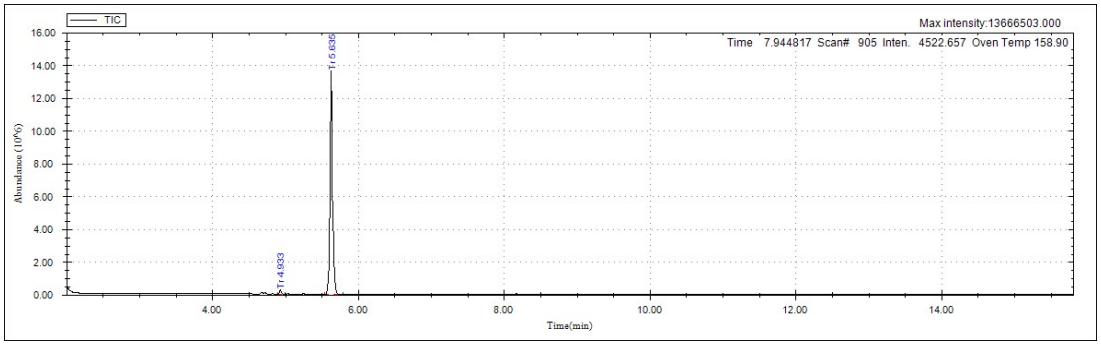
Molecular Weight: 106.16

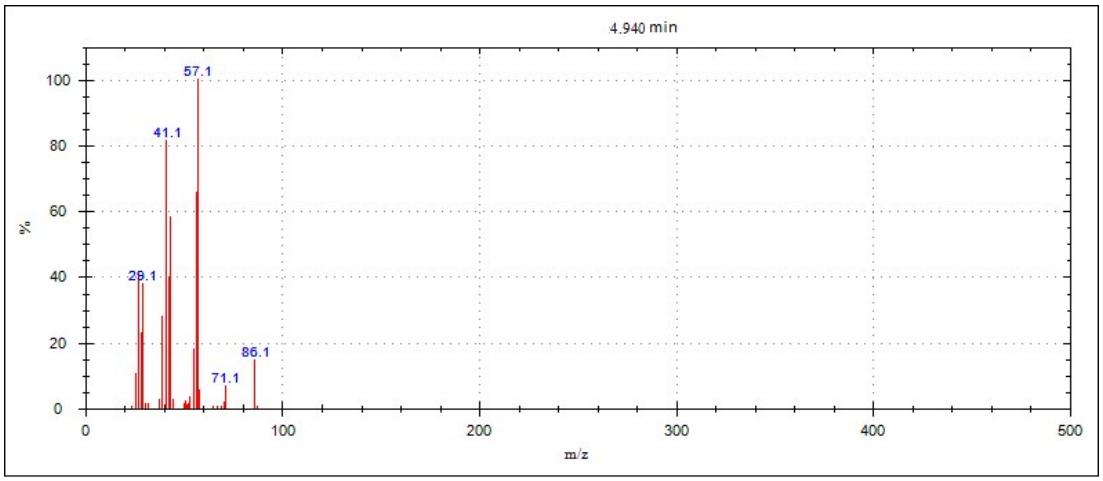




1- Hexane (C_6H_{14}), t_r = 4.940 min

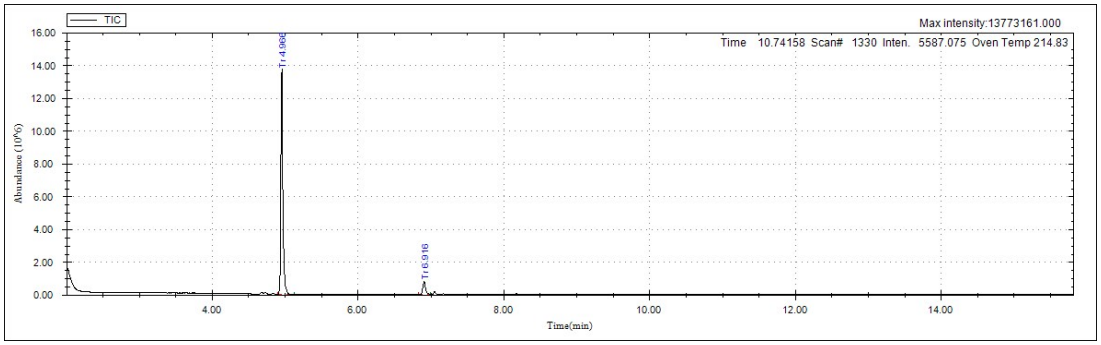
Molecular Weight: 86.18

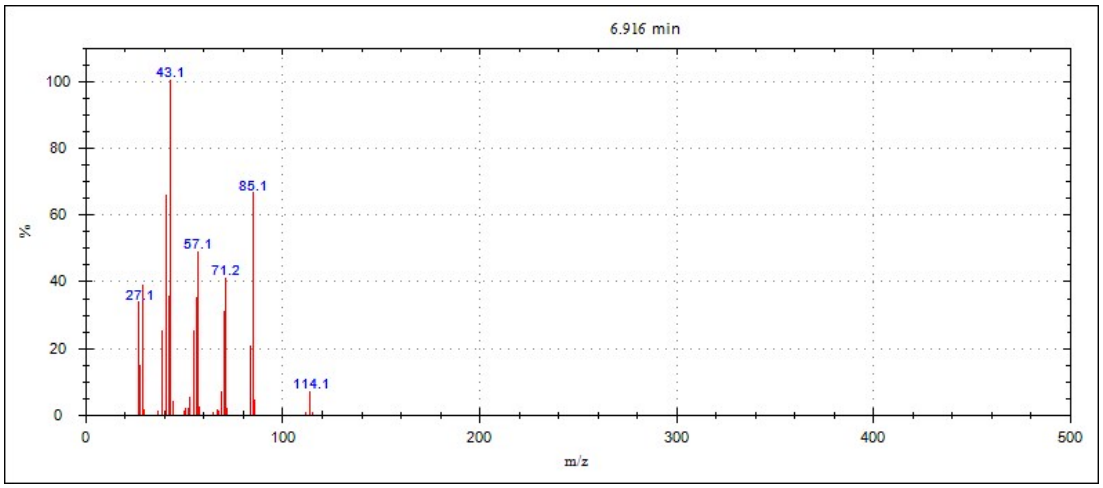




1-Octane (C_8H_{18}) , t_r = 6.916 min

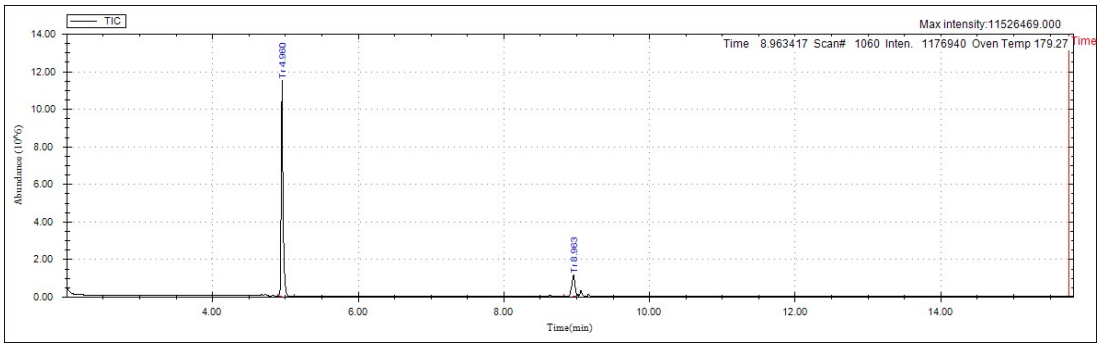
Molecular Weight: 114.23

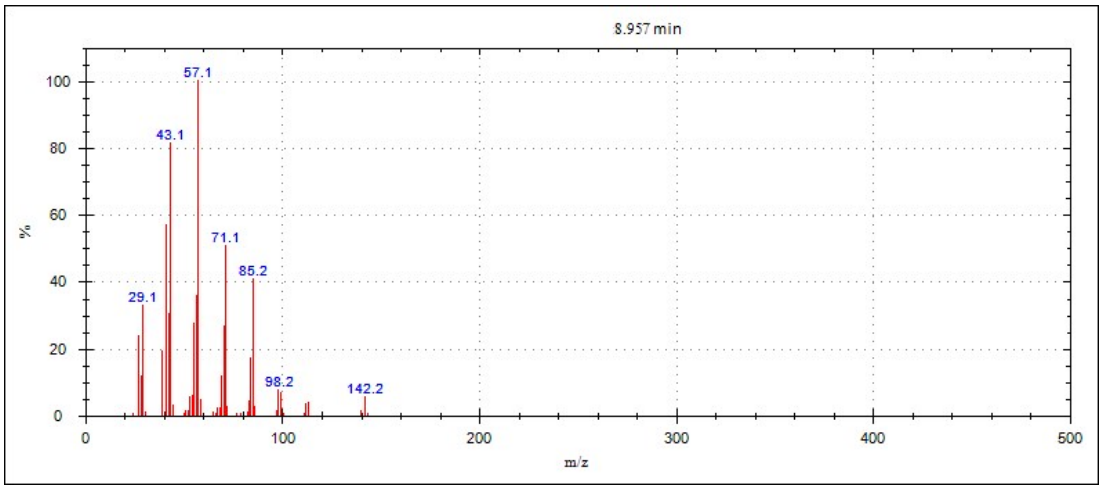




Decane ($C_{10}H_{22}$) , t_r = 8.957 min

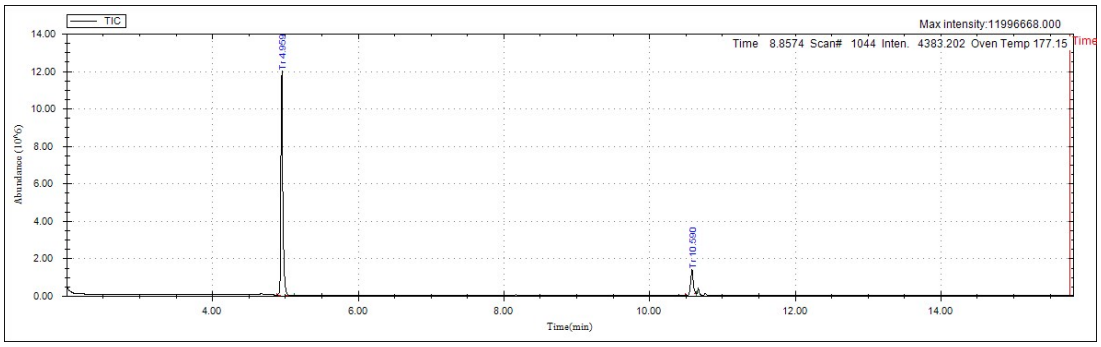
Molecular Weight: 142.29

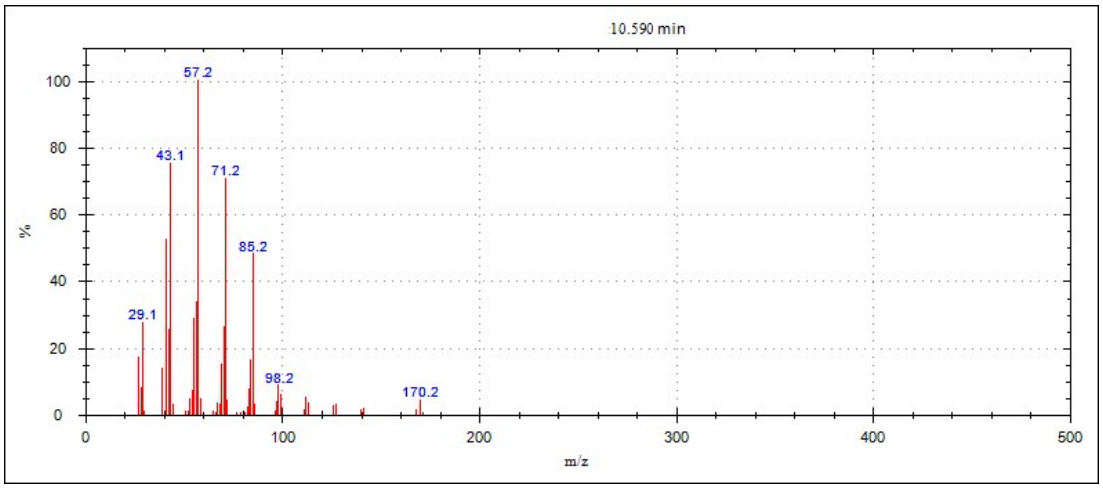




n-Dodecane($C_{12}H_{26}$) , t_r = 10.590min

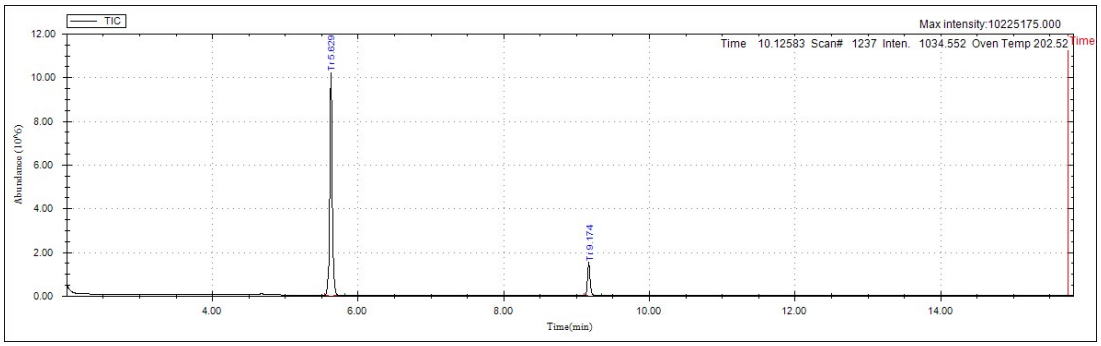
Molecular Weight: 170.33

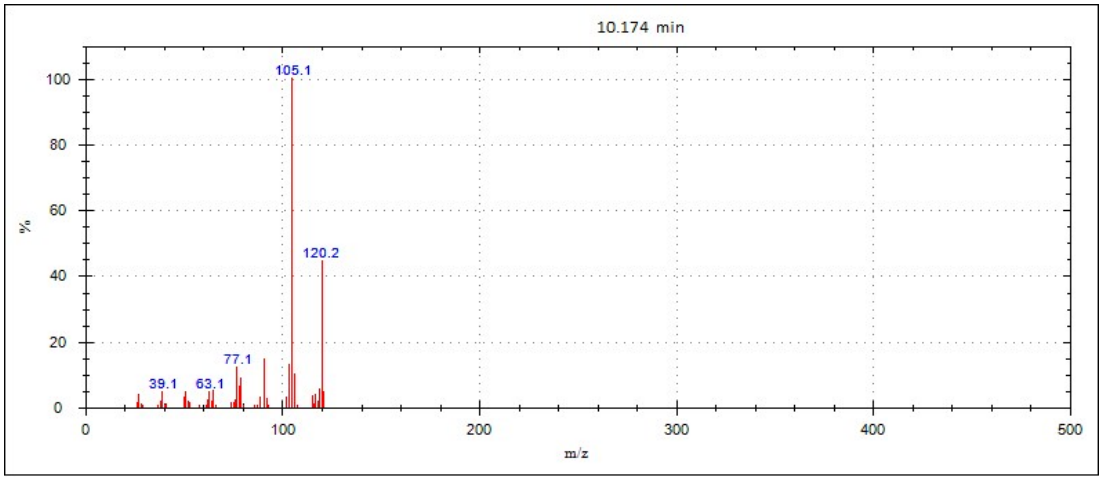




p-Ethyltoluene($C_{12}H_{26}$) , t_r = 10.174min

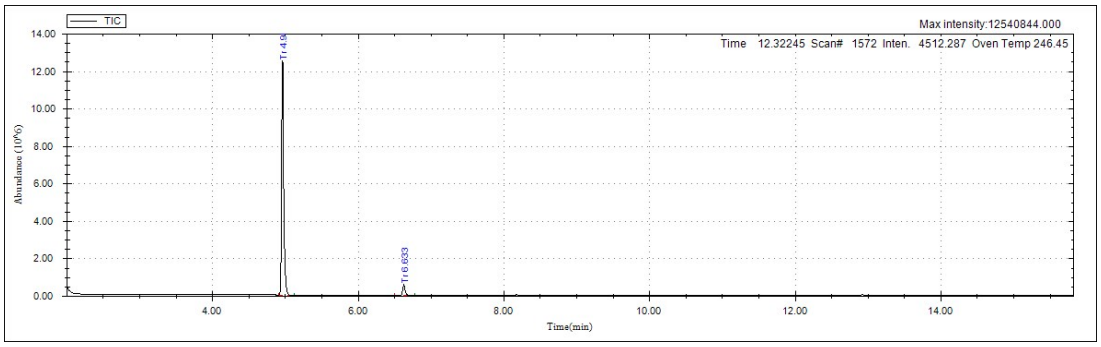
Molecular Weight: 120.19

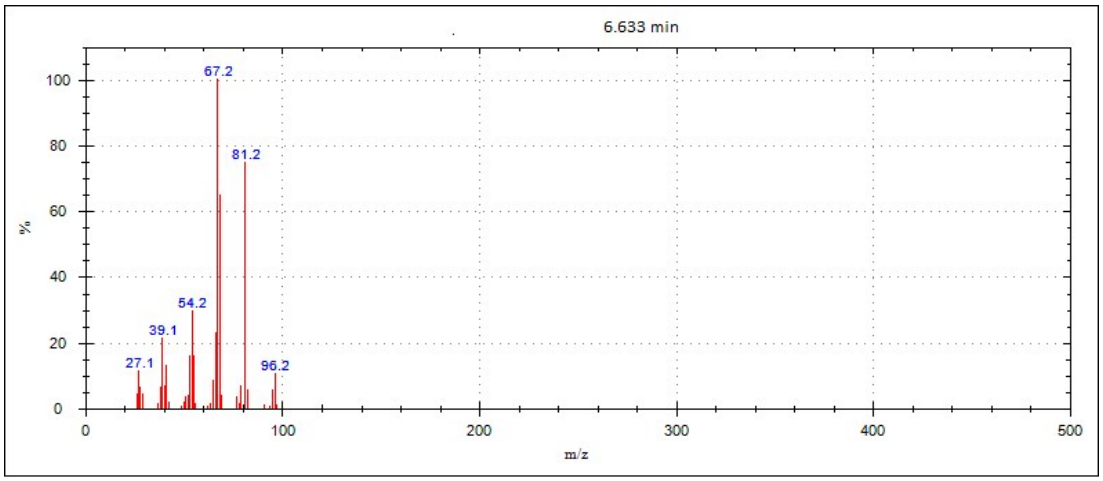




Norbornane(C_7H_{12}) , t_r =6.633min

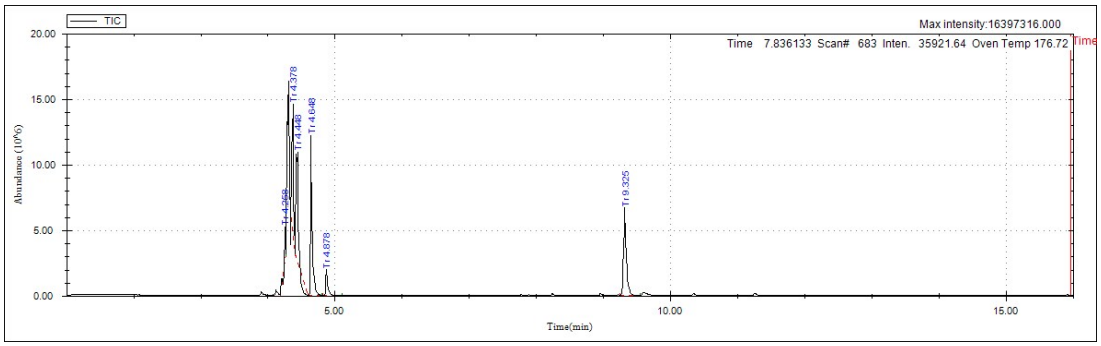
Molecular Weight: 96.17

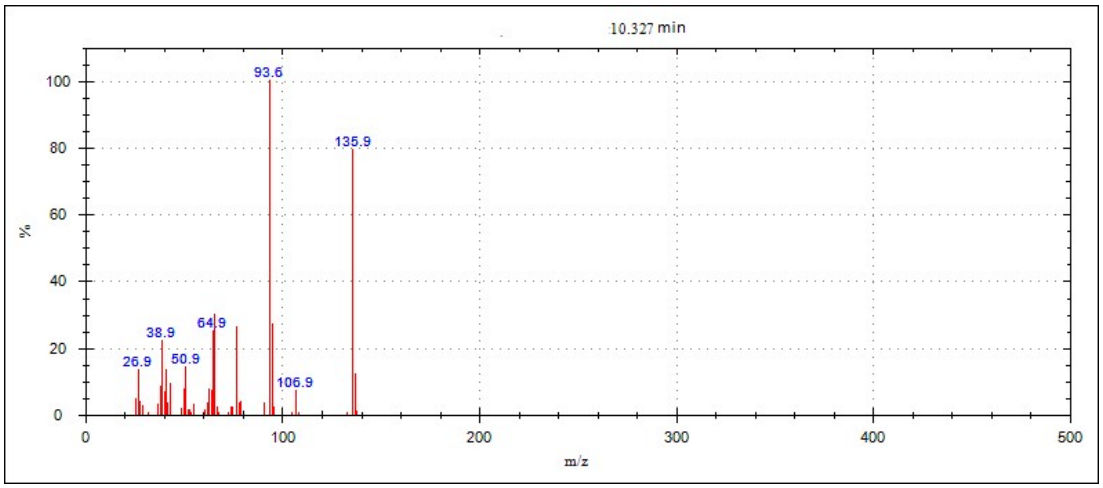




Phenyl propyl ether($C_9H_{12}O$) , t_r =10.326min

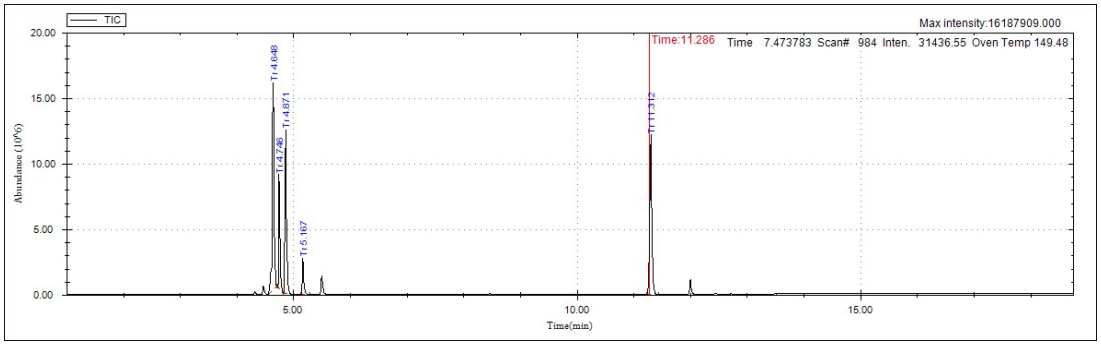
Molecular Weight:136.19

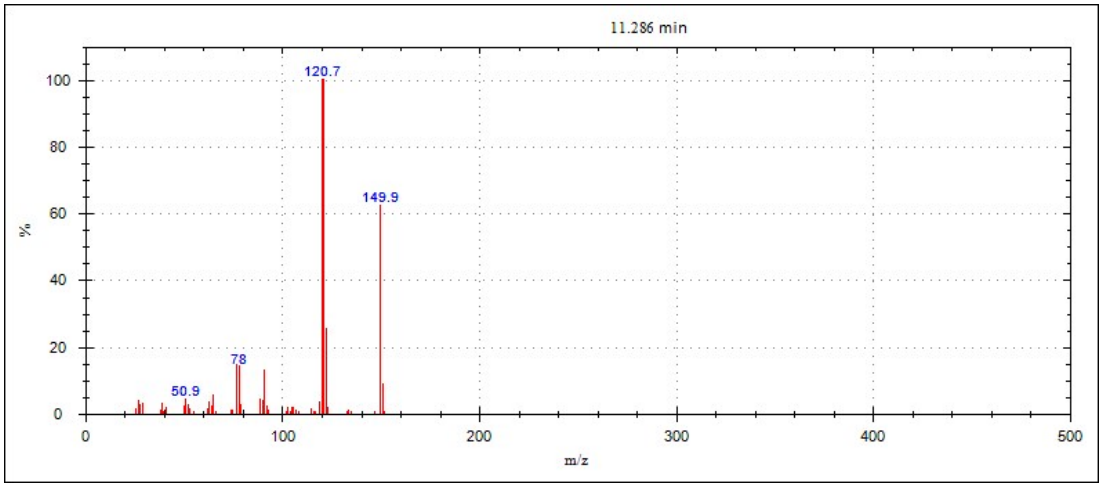




p-Propyl anisole($C_{10}H_{14}O$) , t_r =11.286min

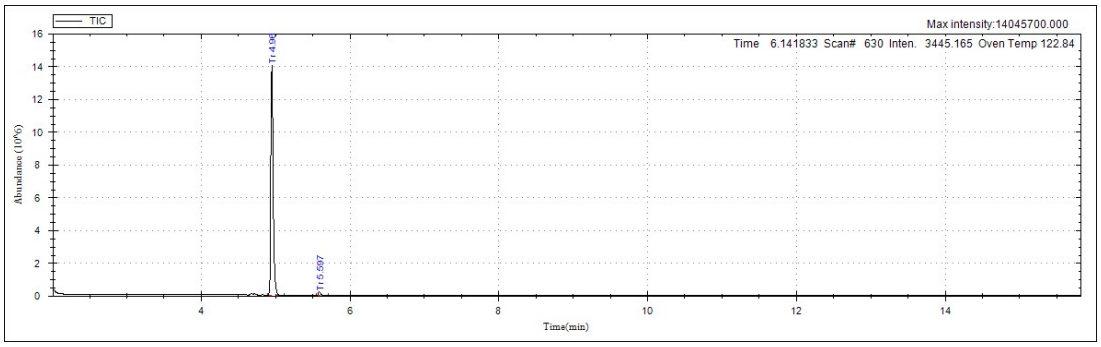
Molecular Weight: 150.24

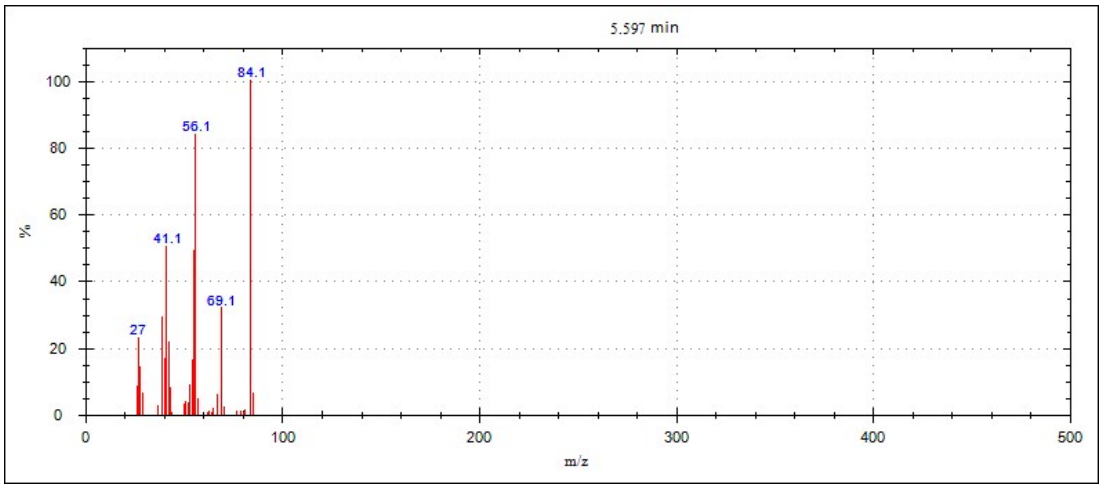




Cyclohexane(C_6H_{12}) , t_r =5.597min

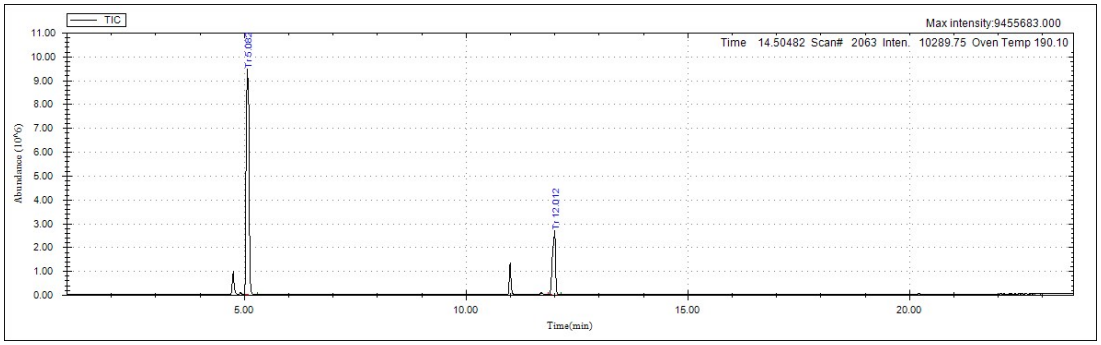
Molecular Weight: 84.16

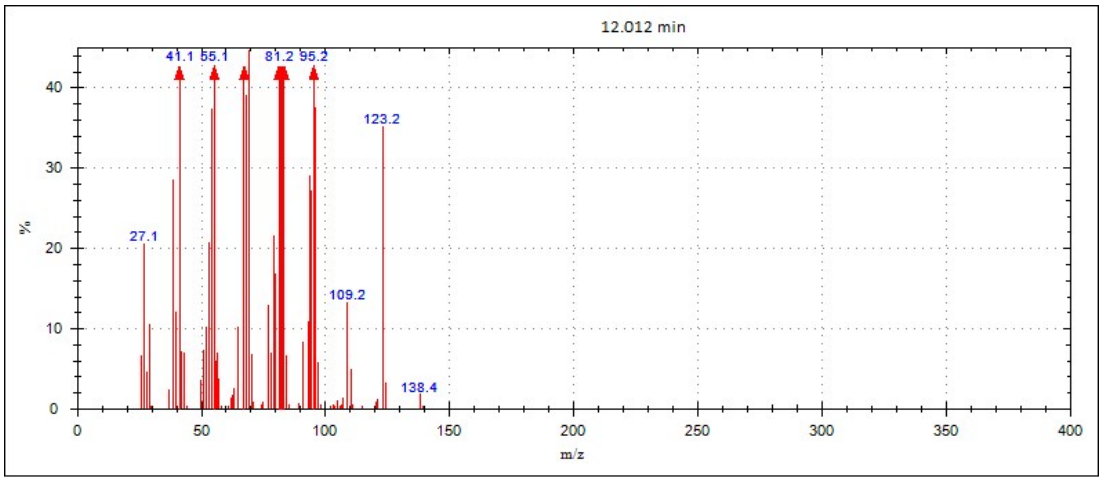




Pinane($C_{10}H_{18}$) , t_r =12.012min (product from reduction ofα- pinene)

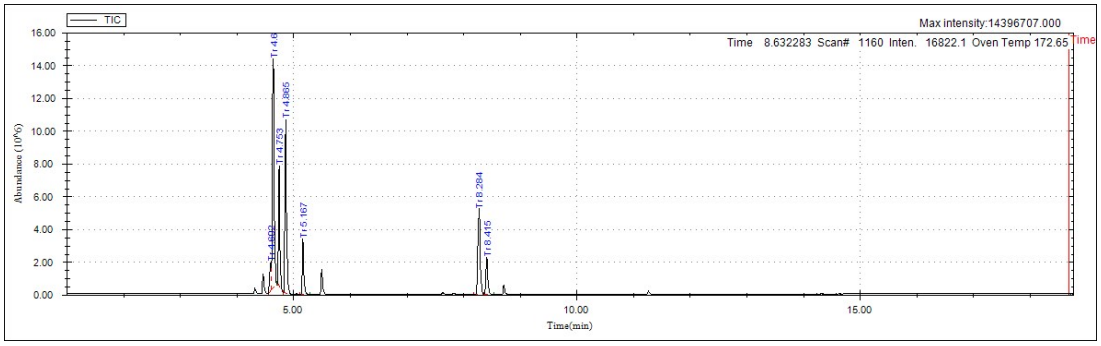
Molecular Weight: 138.25

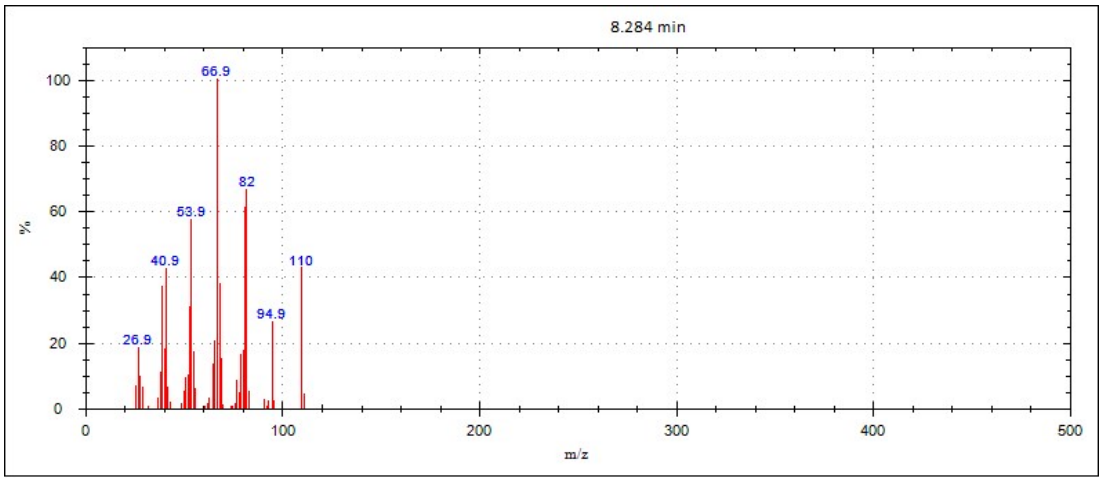


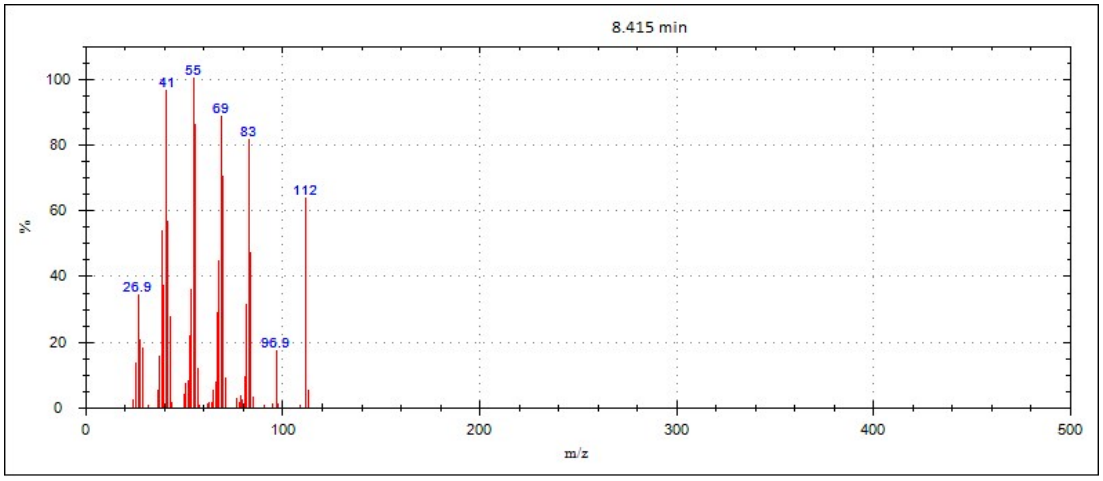


Cyclooctene(C_8H_{14}) , t_r =8.284min, Molecular Weight: 110.20

Cyclooctane(C_8H_{16}) , t_r =8.415min, Molecular Weight: 112.20

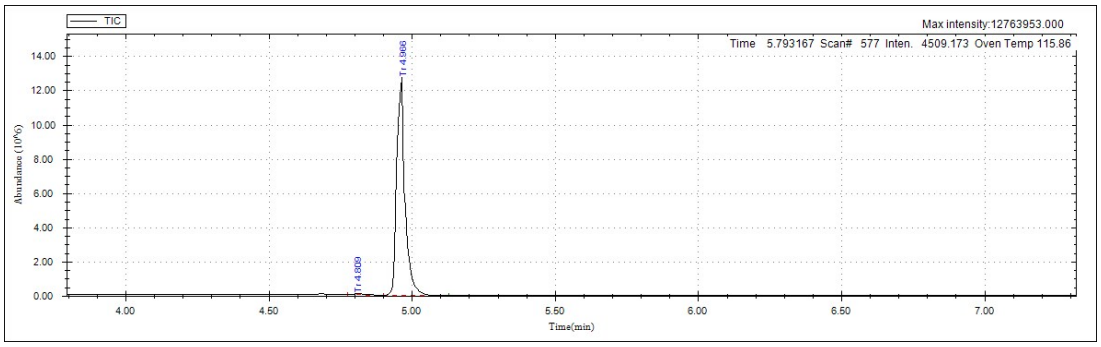






Cyclopentane(C_5H_{10}) , t_r =4.809min

Molecular Weight: 70.13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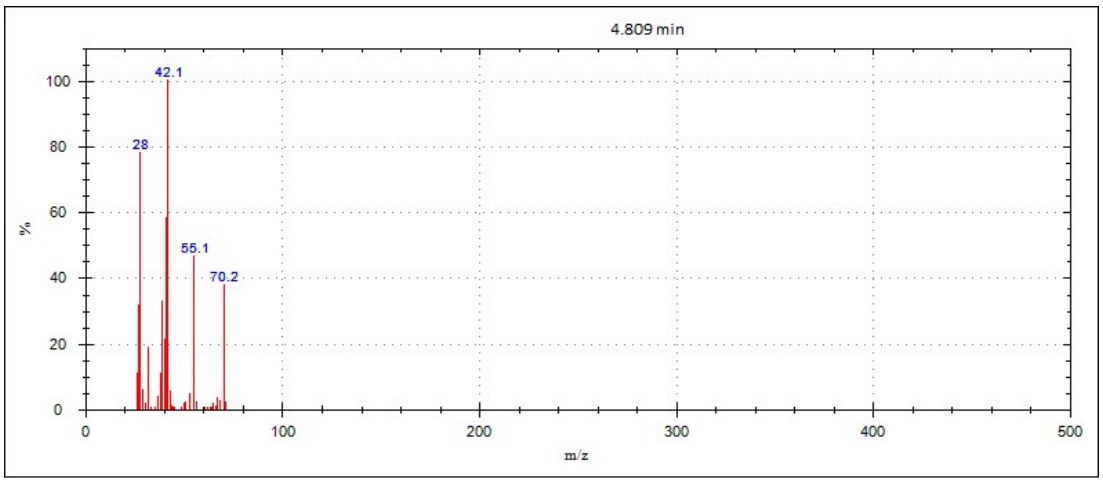
Tr:4.809
Abundance (10^6)
Time(min)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28
55.1
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%
m/z