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# ELECTRONIC SUPPLIMENTARY INFORMATION

## Highly selective production of bio-jet fuel grade alkanes over Fe/ $SiO_2$-$Al_2O_3$ solid acid catalyst under solvent-free conditions

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### Table of contents


| | |
|---|---|
| **Table S1** | SEM-EDS elemental analysis data for $SiO_2$/$Al_2O_3$ containing different Fe loads. |
| **Figure S1-S5** | SEM-EDS elemental mapping of pristine $SiO_2$-$Al_2O_3$ and 4-10wt% Fe/$SiO_2$-$Al_2O_3$ catalyst. |
| **Table S2** | BET analysis surface area and porosity of Fe-loaded $SiO_2$-$Al_2O_3$ samples. |
| **Figure S6** | Nitrogen adsorption-desorption isothermal of $SiO_2$/$Al_2O_3$. |
| **Figure S7** | Temperature-programmed desorption of ammonia ($NH_3$-TPD) profiles of 10wt% $SiO_2$-$Al_2O_3$. |
| **Figure S8** | GC chromatogram of 10% Fe/$SiO_2$/$Al_2O_3$ catalyst at optimized reaction conditions (Entry 5). |
| **Figure S9** | GC chromatograms of 10% Fe/$SiO_2$-$Al_2O_3$ catalyst at 1, 3 and 5 hours. |
| **Figure S10** | GC chromatograms of 10% Fe/$SiO_2$-$Al_2O_3$ catalyst at 400°C. |
| **Figure S11** | GC chromatograms of 10% Fe/$SiO_2$-$Al_2O_3$ catalyst at 3, 5 and 8 bar. |
| **Figure S12** | GC chromatograms of pure Linseed FAME and Neem FAME (red) and after hydrotreatment using 10% Fe/$SiO_2$-$Al_2O_3$ (Blue) at 380°C, 5 bar for 5h. |
| **Table S13** | GC chromatograms of pure Rapeseed FAME and Tung FAME (red) and after hydrotreatment using 10% Fe/$SiO_2$-$Al_2O_3$ (Blue) at 380°C, 5 bar for 5h. |

| | |
|---|---|
| **Figure S3** | The major compositions of palm oil, Repeseed, Linseed, Neem, Soyabeen, Sunflower and Corn oil. |
| **Figure S14** | GC chromatogram of 10% Fe $SiO_2/Al_2O_3$ catalyst at optimized reaction conditions (Entry 5). |
| **Figure S15** | Nitrogen adsorption-desorption isothermal of $SiO_2/Al_2O_3$. |
| **Figure S16** | HRMS spectra of the pure methyl oleate spectra. |
| **Figure S17** | HRMS spectra of 10% $Fe/SiO_2$-$Al_2O_3$ catalyst at 5 h of reaction condition. |
| **Figure S18** | $^{1}H$ NMR of the of catalytic hydrotreatment reaction using 10% $Fe/SiO_2$-$Al_2O_3$ catalyst. |
| **Figure S19** | $^{13}C$ NMR of the of catalytic hydrotreatment reaction using 10% $Fe/SiO_2$-$Al_2O_3$ catalyst. |

Table S1: SEM-EDS elemental analysis data for $SiO_2/Al_2O_3$ containing different Fe loads.

| Elements | 4% Fe/$SiO_2/Al_2O_3$ | | 6% Fe/$SiO_2/Al_2O_3$ | | 8% Fe/$SiO_2/Al_2O_3$ | | 10% Fe/ $SiO_2/Al_2O_3$ | |
|---|---|---|---|---|---|---|---|---|
| | Weight% | Atomic% | Weight% | Atomic% | Weight% | Atomic% | Weight% | Atomic% |
| O K | 51.24 | 65.99 | 50.84 | 65.99 | 54 | 68.85 | 53.81 | 70.42 |
| Al K | 2.92 | 2.16 | 2.81 | 1.94 | 2.27 | 1.71 | 1.95 | 1.45 |
| Si K | 42.01 | 30.04 | 40.31 | 29.84 | 36.27 | 26.68 | 34.5 | 24.58 |
| Fe K | 3.83 | 1.43 | 6.04 | 2.23 | 7.47 | 2.76 | 9.74 | 3.55 |

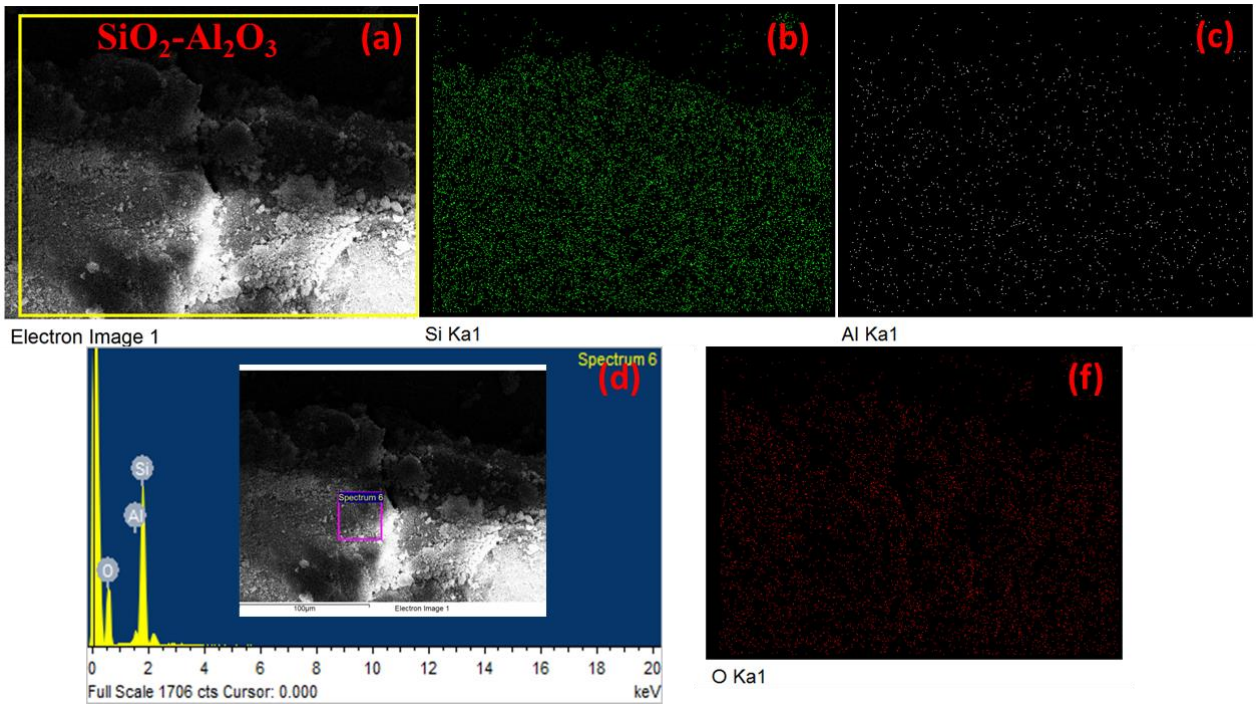



Figure S1: SEM-EDS elemental mapping of pristine $SiO_2$-$Al_2O_3$ catalyst.

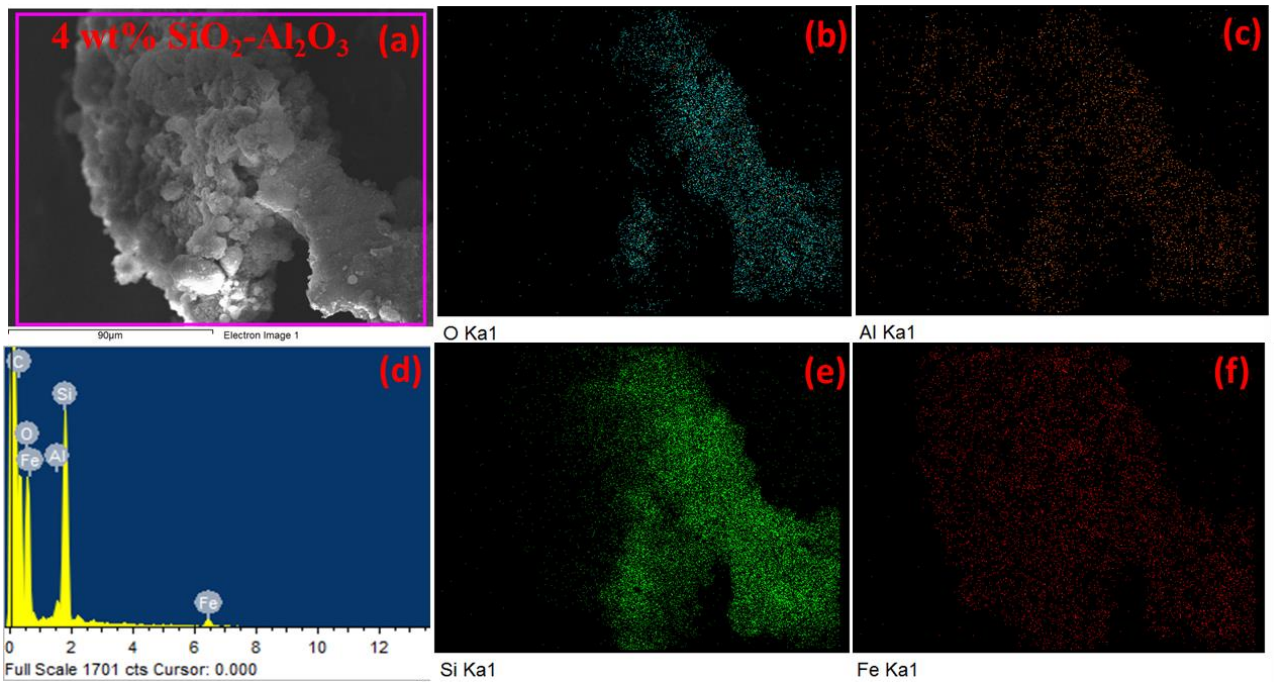



Figure S2: SEM-EDS elemental mapping of 4 wt% $Fe/SiO_2$-$Al_2O_3$ catalyst.

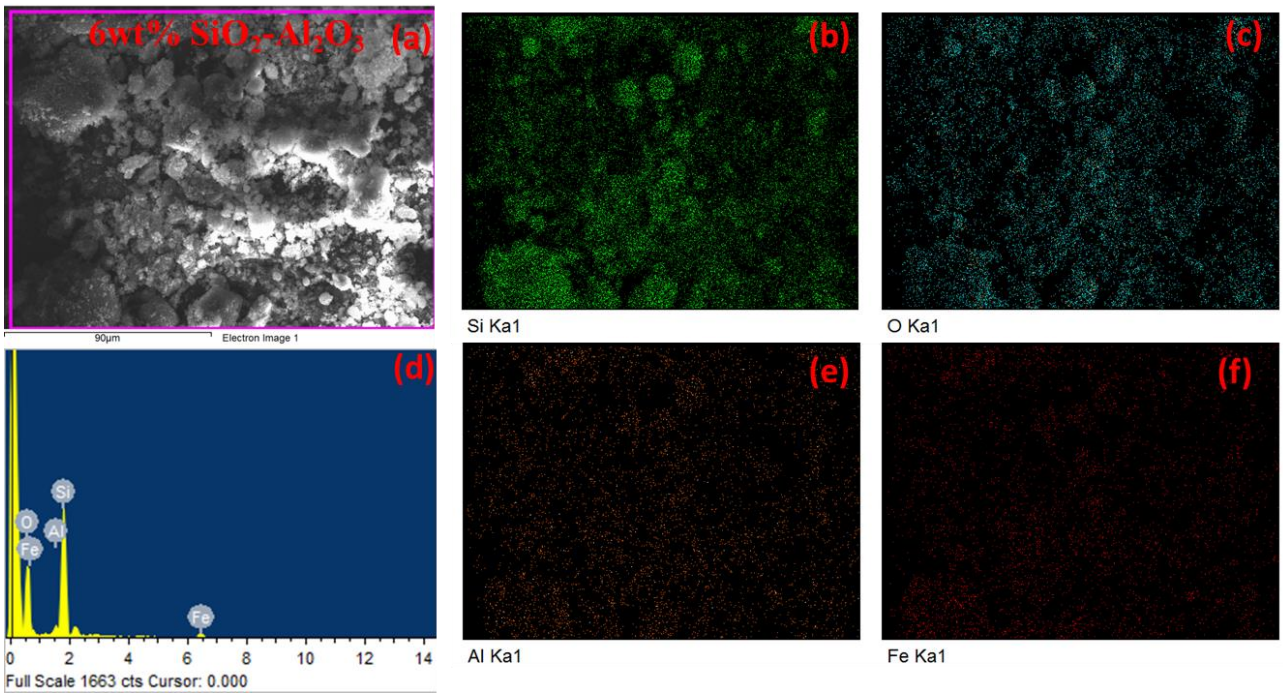



Figure S3: SEM-EDS elemental mapping of 6 wt% $Fe/SiO_2$-$Al_2O_3$ catalyst.

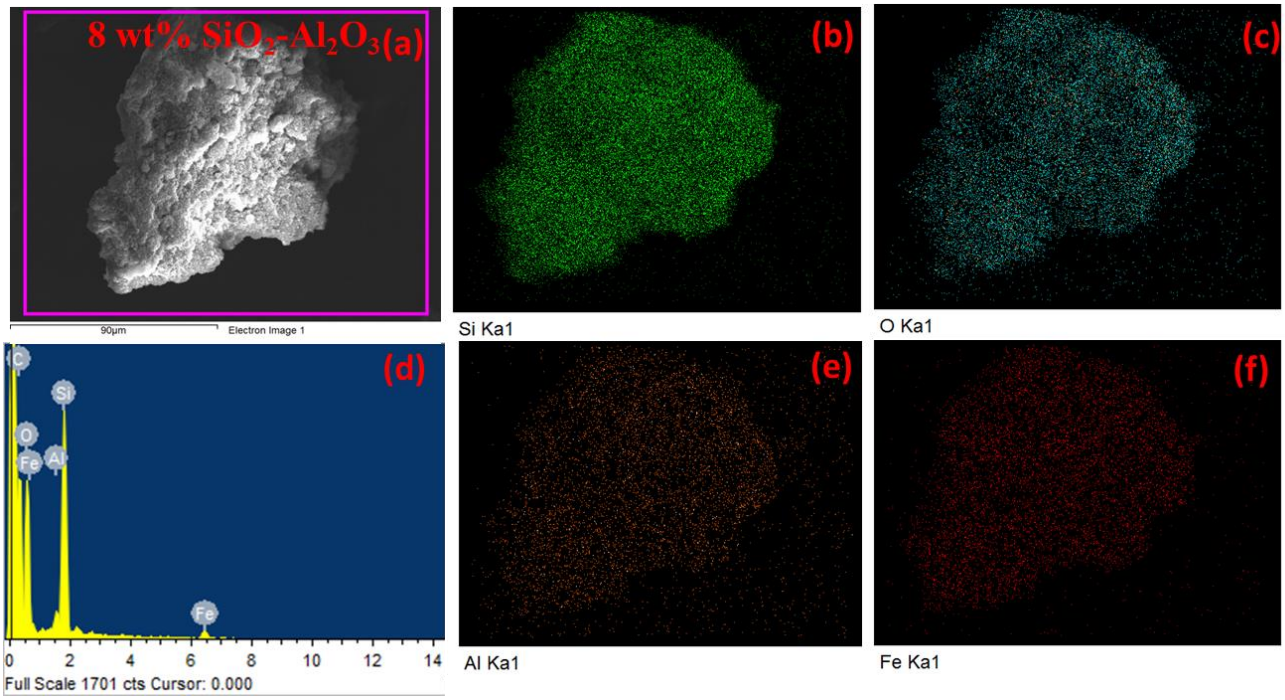
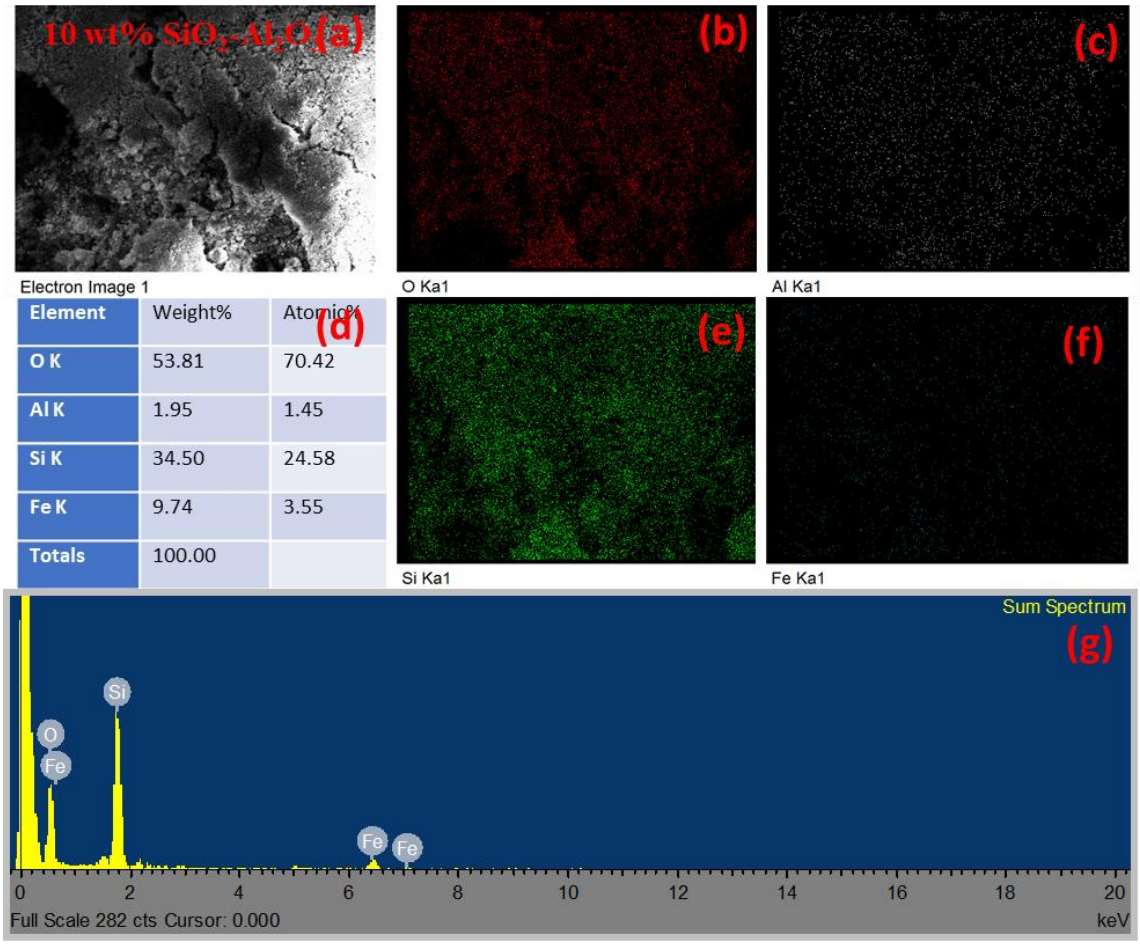



Figure S4: SEM-EDS elemental mapping of 8 wt% Fe/$SiO_2$-$Al_2O_3$ catalyst.




| Element | Weight% | Atomic% |
|---|---|---|
| O K | 53.81 | 70.42 |
| Al K | 1.95 | 1.45 |
| Si K | 34.50 | 24.58 |
| Fe K | 9.74 | 3.55 |
| Totals | 100.00 | |

Figure S5: SEM-EDS elemental mapping of 10 wt% Fe/$SiO_2$-$Al_2O_3$ catalyst

| Sr. No | Catalyst | Surface Area ($m^2g^{-1}$) | Pore Volume (CC/g) | Pore Radius (nm) |
|---|---|---|---|---|
| 1 | $SiO_2$-$Al_2O_3$ | 213.86 | 0.280 | 3.59 |
| 1 | 4wt% Fe/$SiO_2$-$Al_2O_3$ | 97.765 | 0.185 | 2.14 |
| 2 | 6wt% Fe/$SiO_2$-$Al_2O_3$ | 89.237 | 0.094 | 1.93 |
| 3 | 8wt% Fe/$SiO_2$-$Al_2O_3$ | 78.7111 | 0.0772 | 1.96 |
| 4 | 10wt% Fe/$SiO_2$-$Al_2O_3$ | 52.209 | 0.0432 | 1.65 |

Table S2: BET analysis surface area and porosity of Fe-loaded $SiO_2$-$Al_2O_3$ samples.

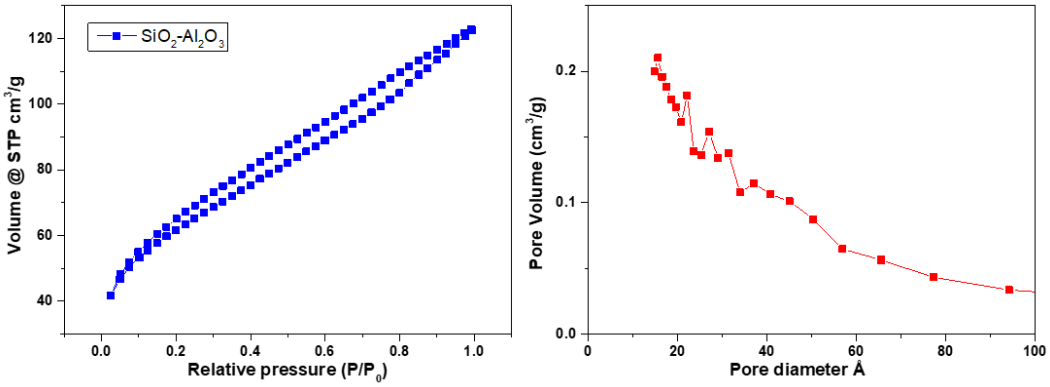



Figure S6. Nitrogen adsorption-desorption isothermal of $SiO_2$/$Al_2O_3$.

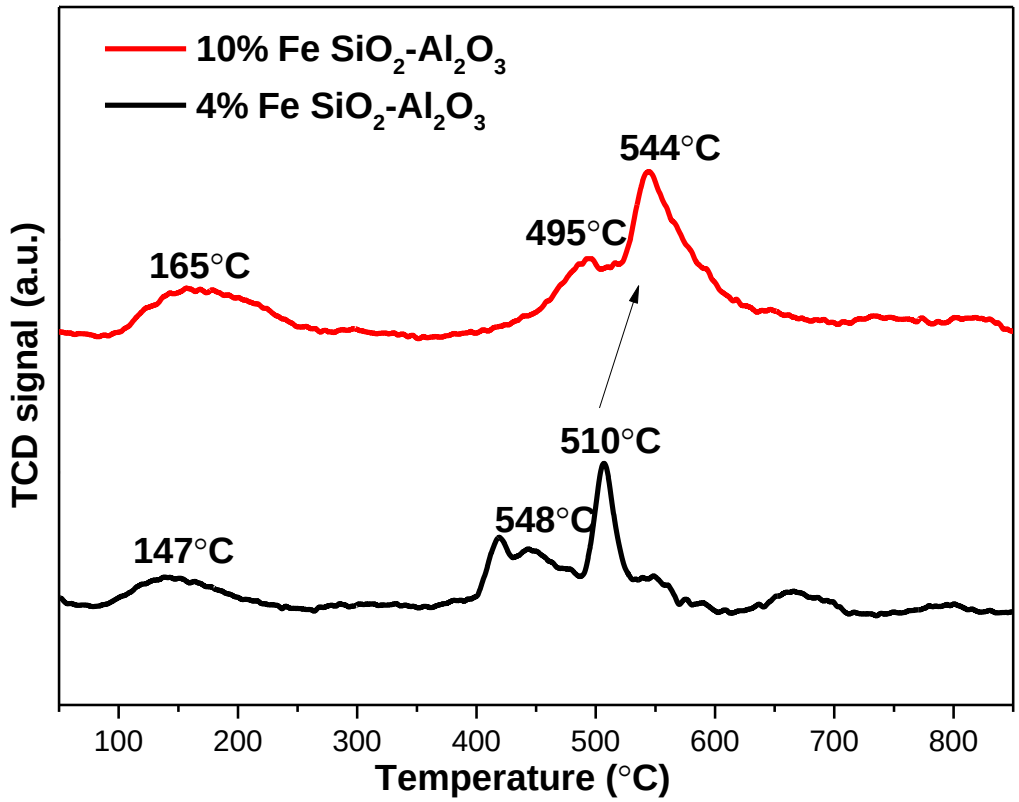



Figure S7: Temperature-programmed desorption of ammonia ($NH_3$-TPD) profiles of 10wt% $SiO_2$-$Al_2O_3$.

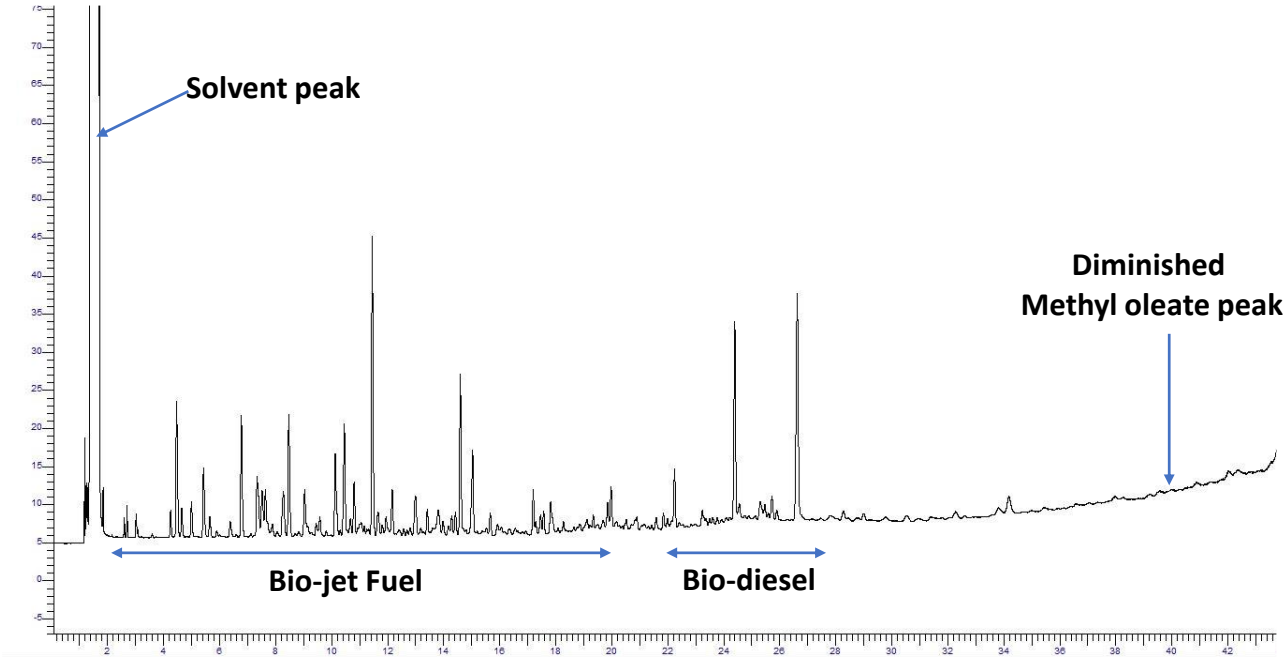



Figure S8: GC chromatogram of 10% Fe/$SiO_2$/$Al_2O_3$ catalyst at optimized reaction conditions (Entry 5).

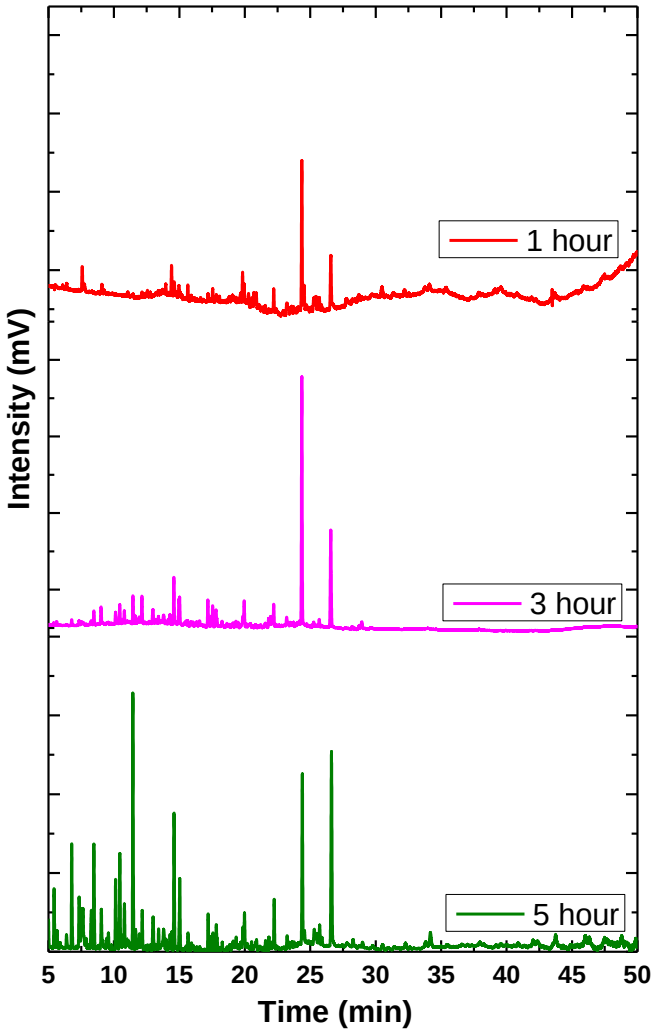



Figure S9: GC chromatograms of 10% Fe/$SiO_2$-$Al_2O_3$ catalyst at 1, 3 and 5 hours.

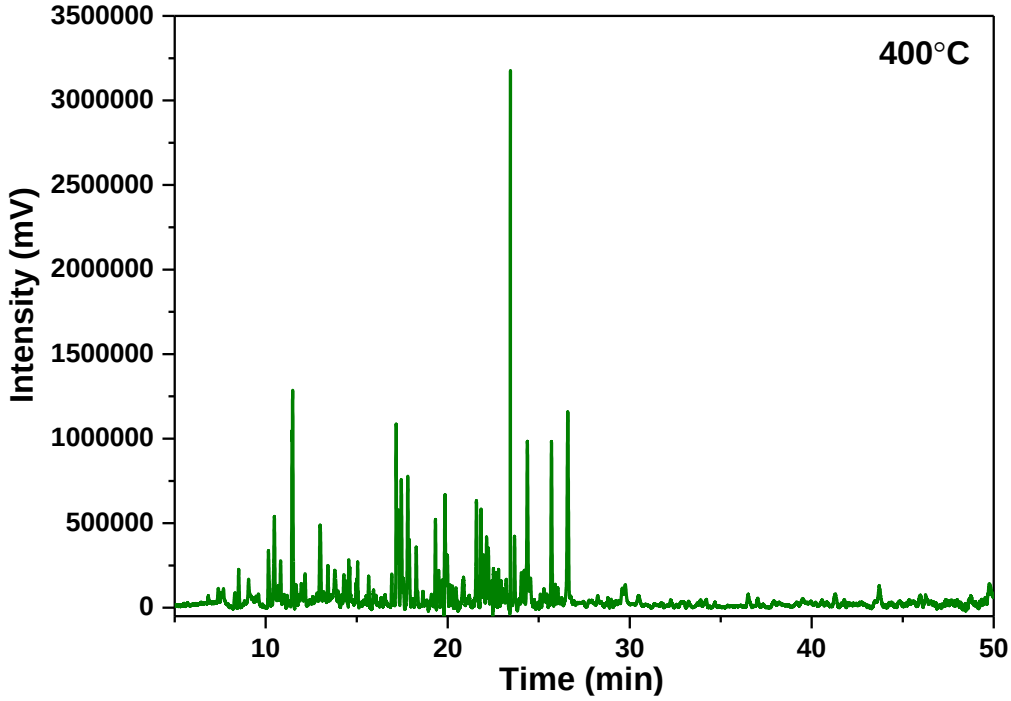



Figure S10: GC chromatograms of 10% Fe/$SiO_2$-$Al_2O_3$ catalyst at 400°C.

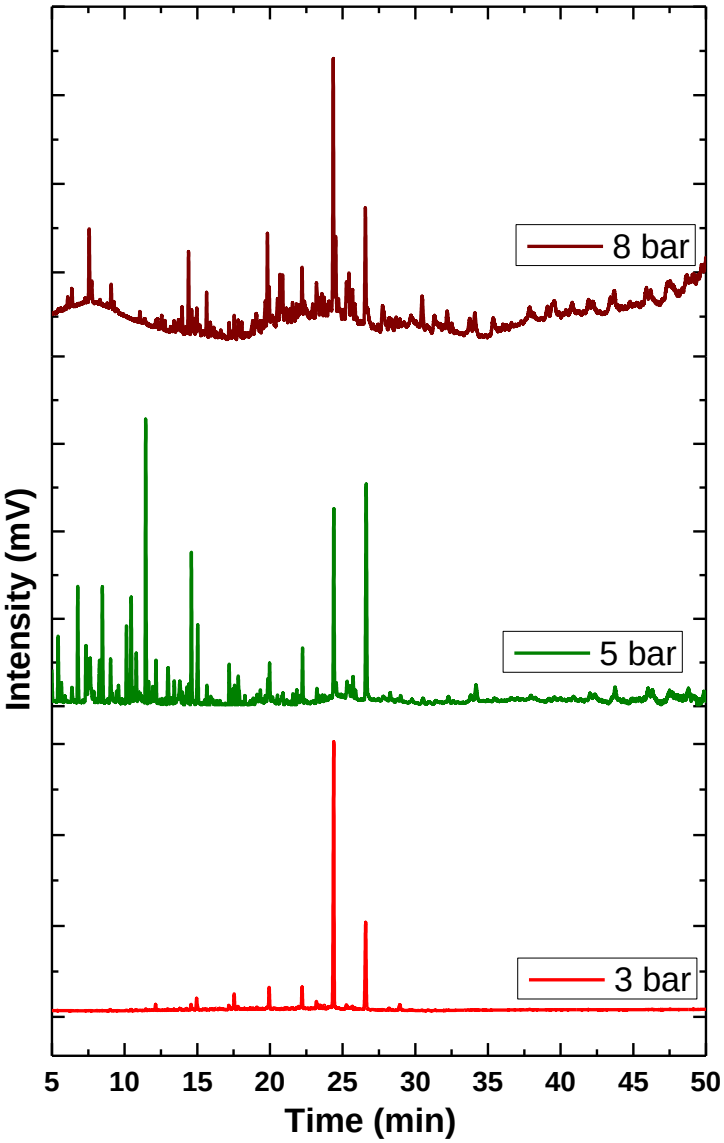



Figure S11: GC chromatograms of 10% Fe/$SiO_2$-$Al_2O_3$ catalyst at 3, 5 and 8 bar.

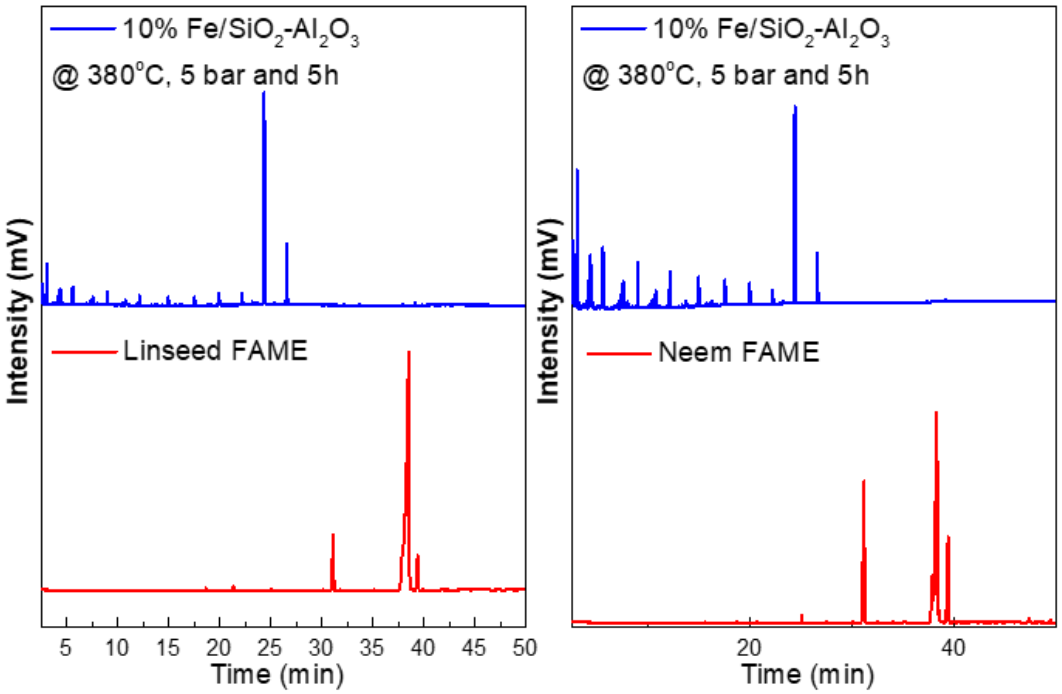



Figure S12: GC chromatograms of pure Linseed FAME and Neem FAME (red) and after hydrotreatment using 10% $Fe/SiO_2$-$Al_2O_3$ (Blue) at 380°C, 5 bar for 5h.

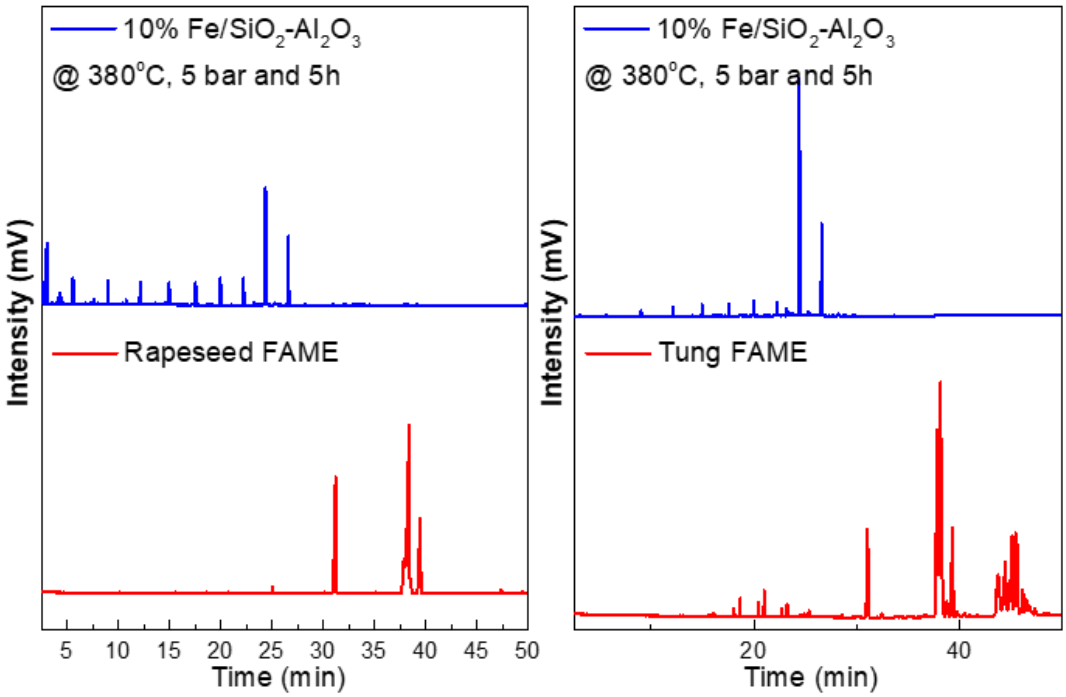



Figure S13: GC chromatograms of pure Rapeseed FAME and Tung FAME (red) and after hydrotreatment using 10% $Fe/SiO_2$-$Al_2O_3$ (Blue) at 380°C, 5 bar for 5h.

Table S3: The major compositions of palm oil, Repeseed, Linseed, Neem, Soyabeen, Sunflower and Corn oil.

| **FAME/ Fatty acid profiles** | **Methyl palmitate (16:0)** | **Methyl stearate (18:0)** | **Methyl oleate (18:1)** | **Methyl linoleate (18:2)** | **Methyl linolenate (18:3)** |
|---|---|---|---|---|---|
| **Palm oil**[1] | 44 | 4.5 | 39.2 | 10.1 | 0.4 |
| **Rapeseed**[2] | 4.8 | 0.14 | 62.73 | 22.4 | 7.50 |
| **Linseed**[3] | 4.90-8.00 | 2.24-4.59 | 13.44-19.39 | 12.25-17.44 | 39.90-60.42 |
| **Neem seed**[4] | 18.1 | 18.1 | 44.45 | 18.3 | 0.2 |
| **Soyabeen**[1] | 11.0 | 4.0 | 23.4 | 53.2 | 7.8 |
| **Sunflower**[1] | - | 4.5 | 21.1 | 66.2 | - |
| **Corn**[1] | 6.5 | 2.2 | 27.5 | 57.0 | 0.9 |

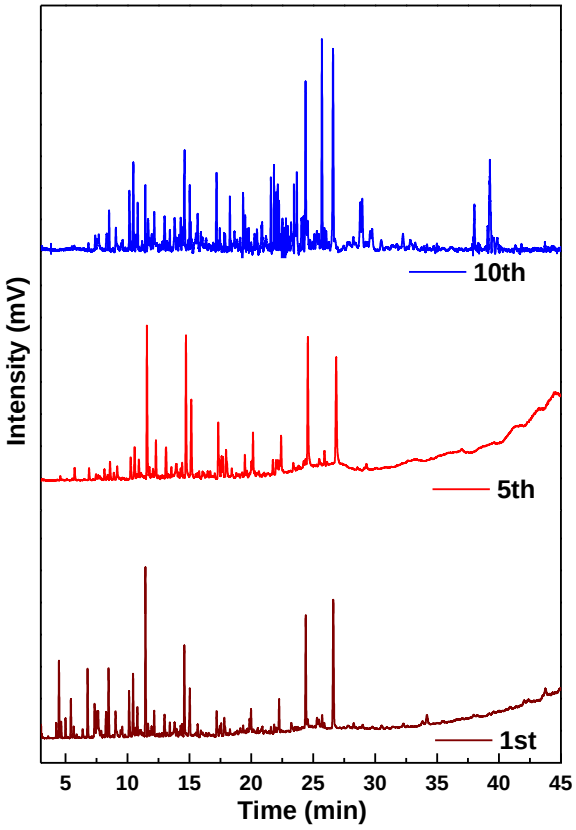



Figure S14: Reusability GC chromatograms of 10% Fe/SiO2-Al2O3 catalyst up to 10 cycles.

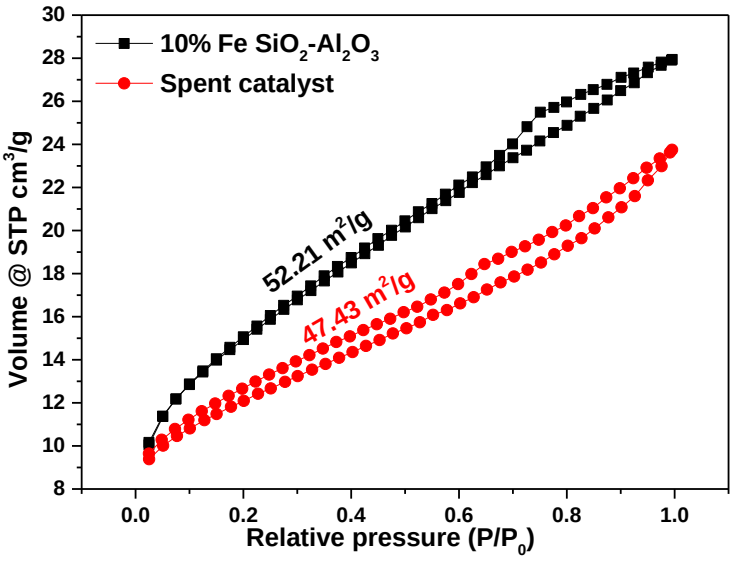


Figure S15. Nitrogen adsorption-desorption isothermal of $SiO_2/Al_2O_3$.

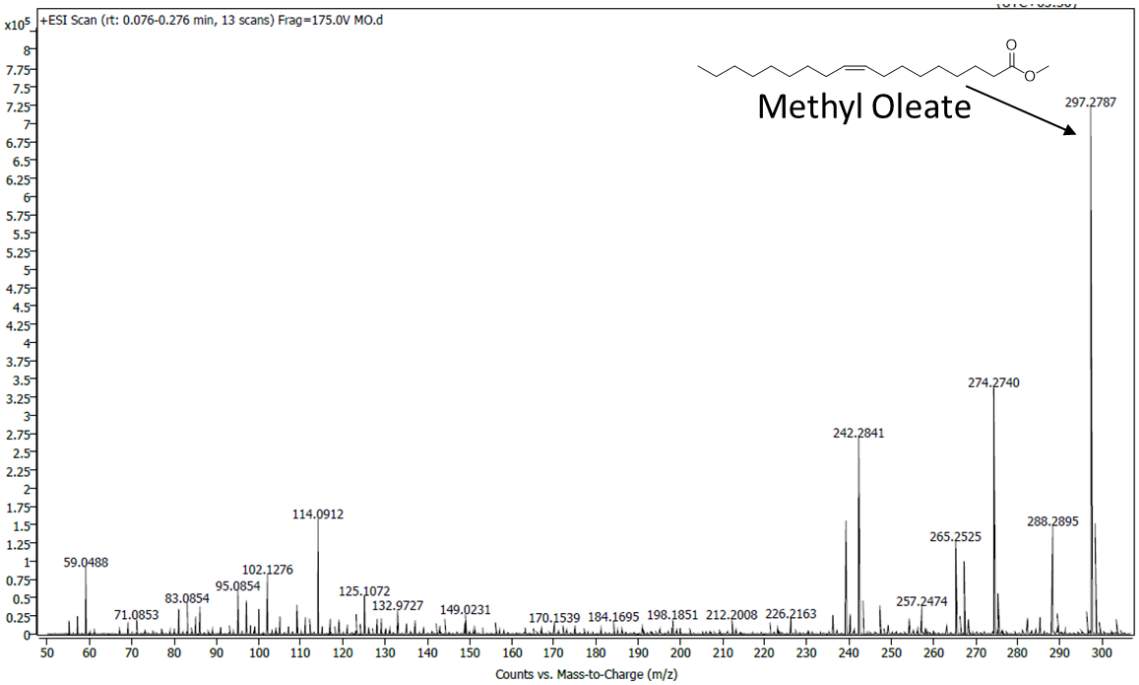



Figure S16: HRMS spectra of the pure methyl oleate spectra.

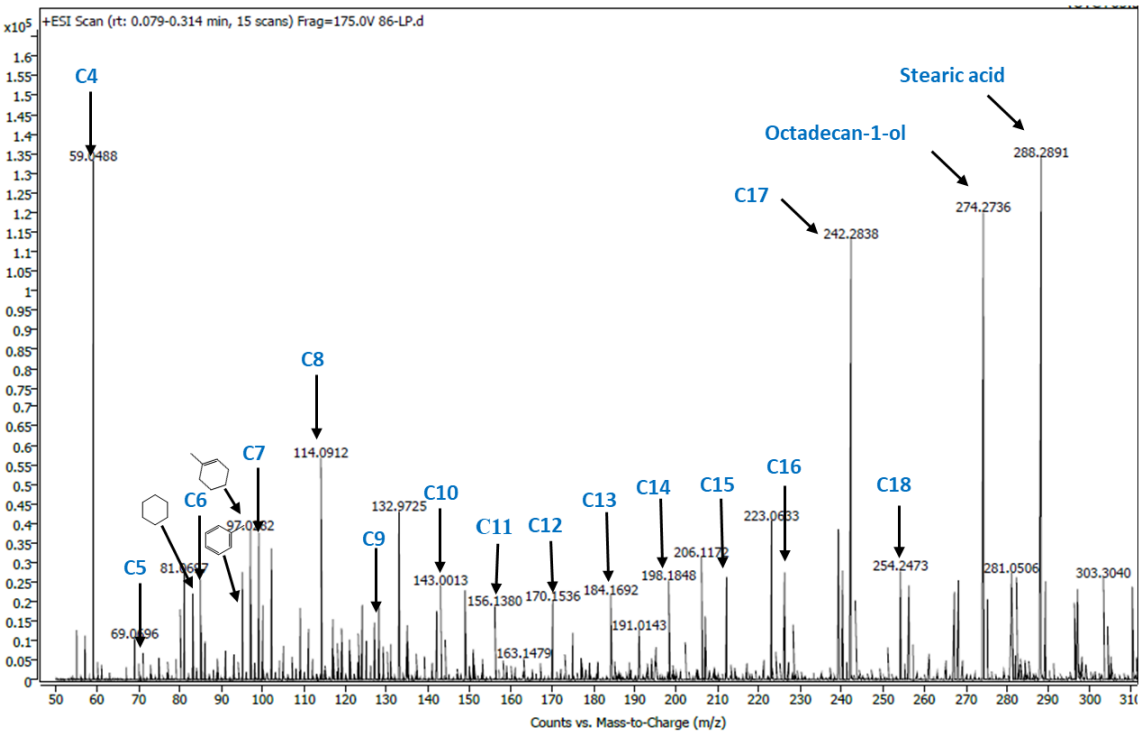



Figure S17: HRMS spectra of 10% $Fe/SiO_2$-$Al_2O_3$ catalyst at 5h of reaction condition.

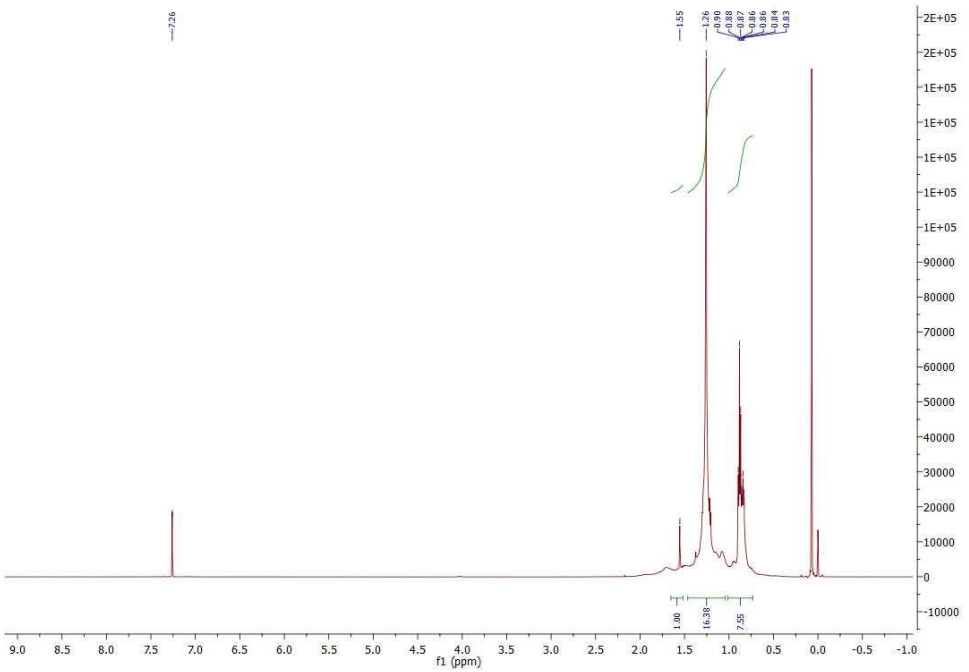



Figure S18: $^{1}H$ NMR of the of catalytic hydrotreatment reaction using 10% $Fe/SiO_2$-$Al_2O_3$ catalyst.

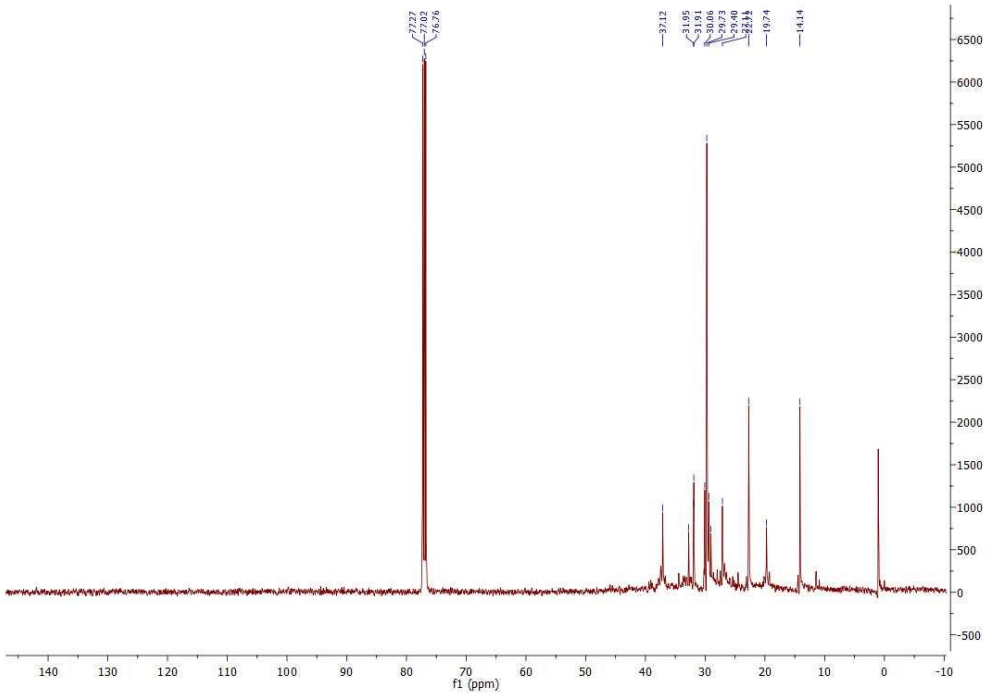



Figure S19: $^{13}C$ NMR of the of catalytic hydrotreatment reaction using 10% $Fe/SiO_2$-$Al_2O_3$ catalyst.

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