Semi-Batch Gasification of Refuse-Derived Fuel (RDF)

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The ^{1}H NMR spectrum (see Figure NMR1) of the studied matter contained a dominant singlet-shaped resonance at 1.36 ppm, which, for d6-benzene, commonly indicates the presence of identical CH_2-groups in grease, polyethylene or other compounds containing long linear alkyl chains. Two sets of NMR signals in the ^{13}C spectrum (Figure NMR2) were distinguished by the combined analysis of correlation signals in the COSY (Figure NMR3 and Figure NMR4), HSQC (Figure NMR5 and Figure NMR6) and HMBC (Figure NMR7) spectra. A very good correlation with the literature was found for the relative chemical shifts of polyethylene signals in [30] measured at 110 °C. Additionally, the multiple bond correlations of the CH- and CH_2-groups' protons with their, seemingly, directly-bonded carbons provided an explicit proof of the presence of identical, repeating and mutually bonded propylene fragments. These correlations were found to be the result of three-bond heteronuclear interactions between the abovementioned protons and the identical CH- and CH_2-groups of the next and previous propylene unit within a polypropylene chain. A small amount of molecules with terminal double-bond moieties were also observed in the liquid state. Due to the limited solubility of the studied matter and the risk of the misinterpretation of the true content of the studied matter due to the inhomogeneity of the liquid-state sample, the white powder was also subjected to solid-state measurements. The spectra obtained from the direct ^{13}C MAS NMR experiment (Figure NMR8) and the experiment utilizing ^{1}H-^{13}C cross-polarization (Figure NMR9) offered a final proof of the dominant content of linear and branched alkyl chains.

NMR Images

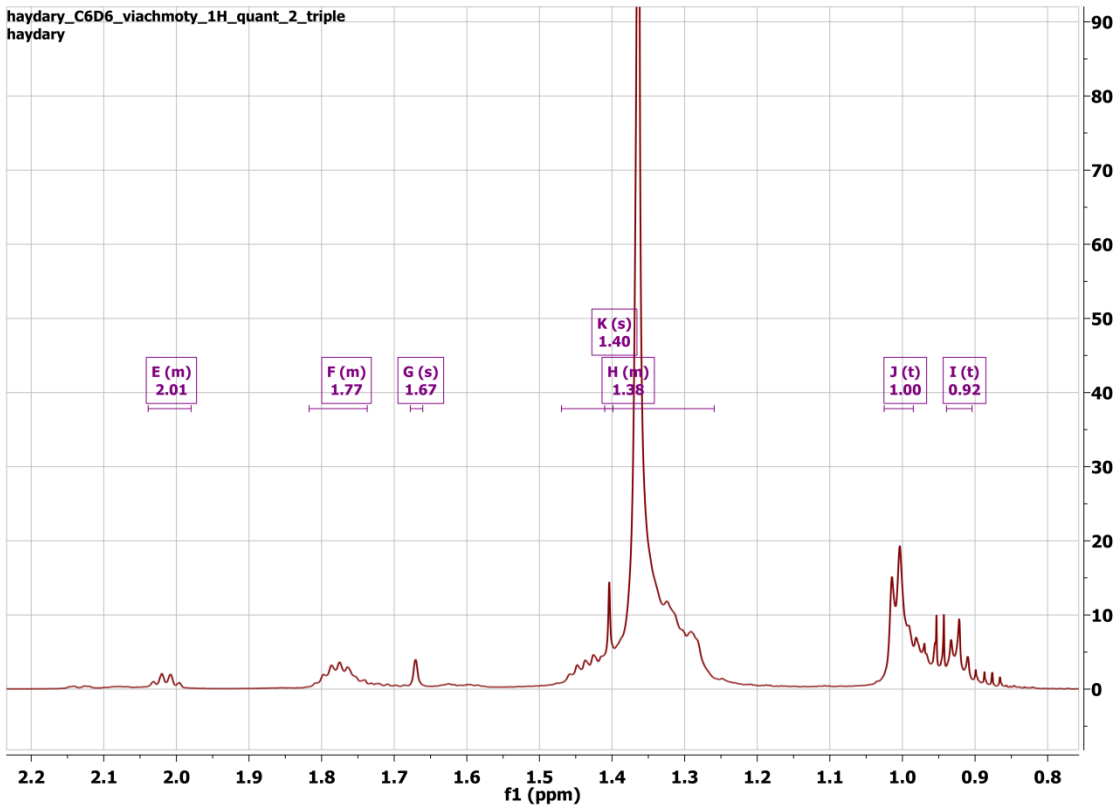

Figure NMR1. The aliphatic part of the liquid state ^{1}H NMR spectrum

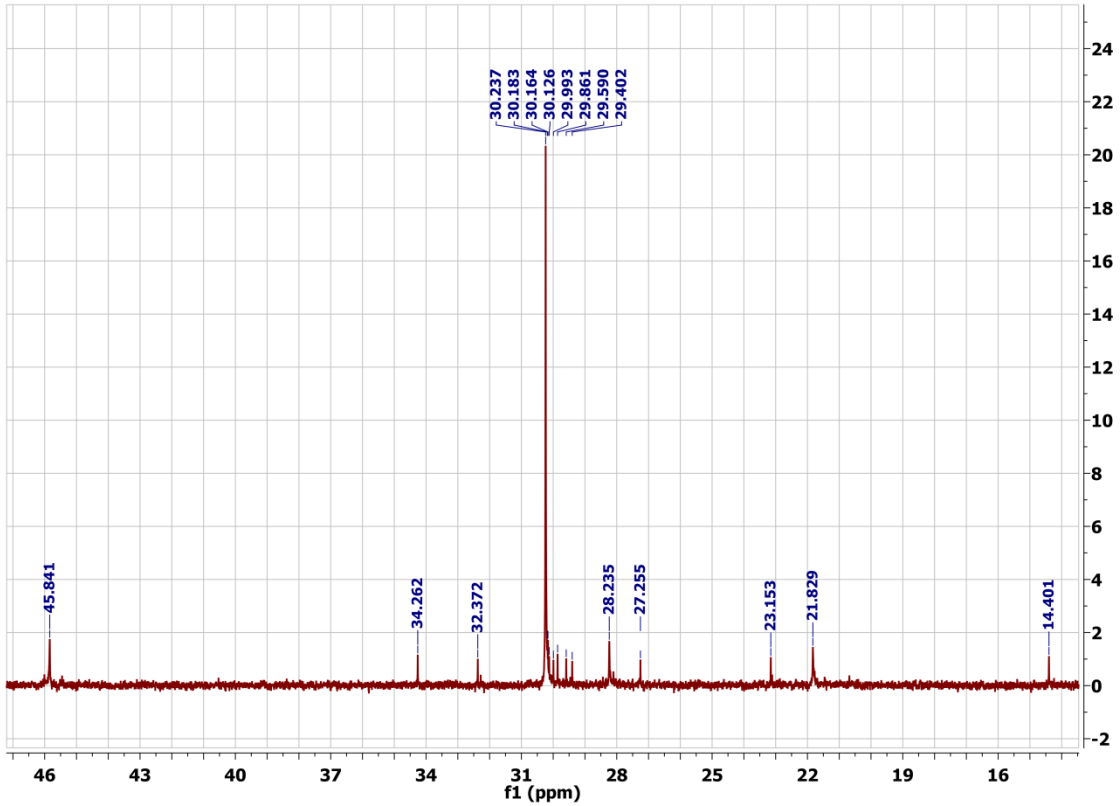

Figure NMR2. The aliphatic part of the liquid state ^{13}C NMR spectrum

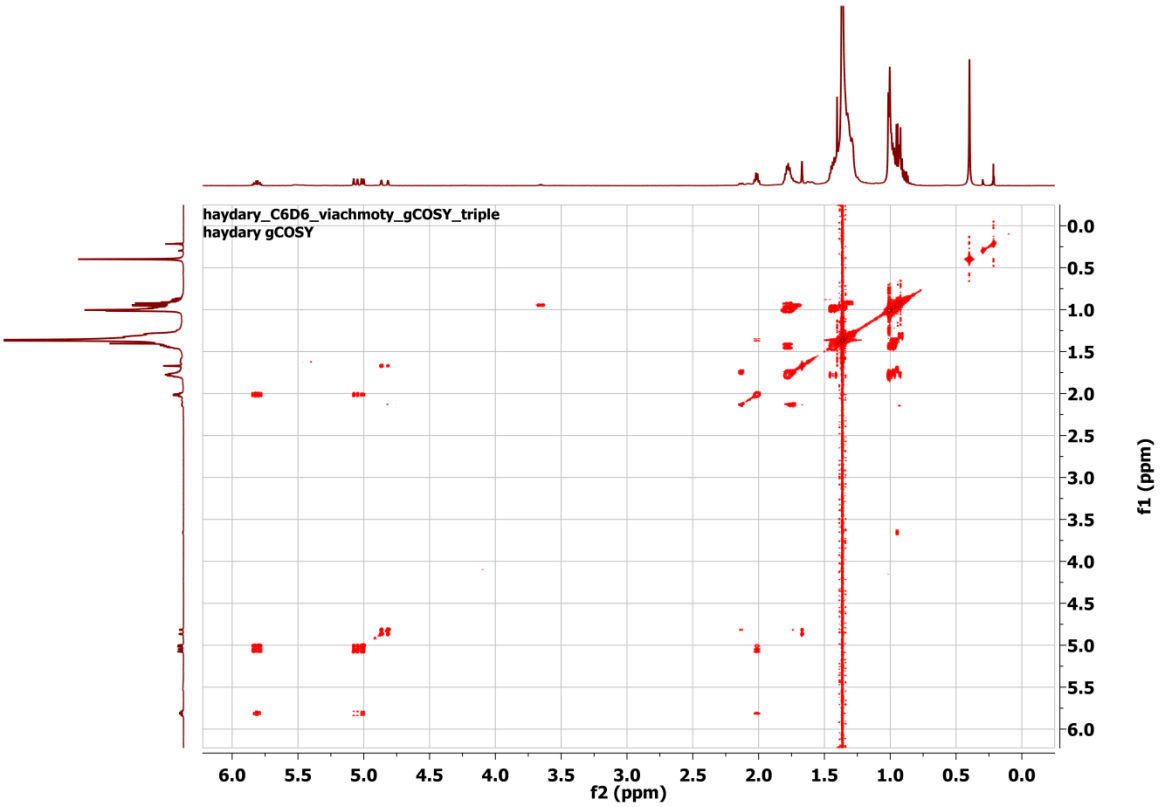

Figure NMR3. 2D COSY NMR spectrum of the liquid state sample

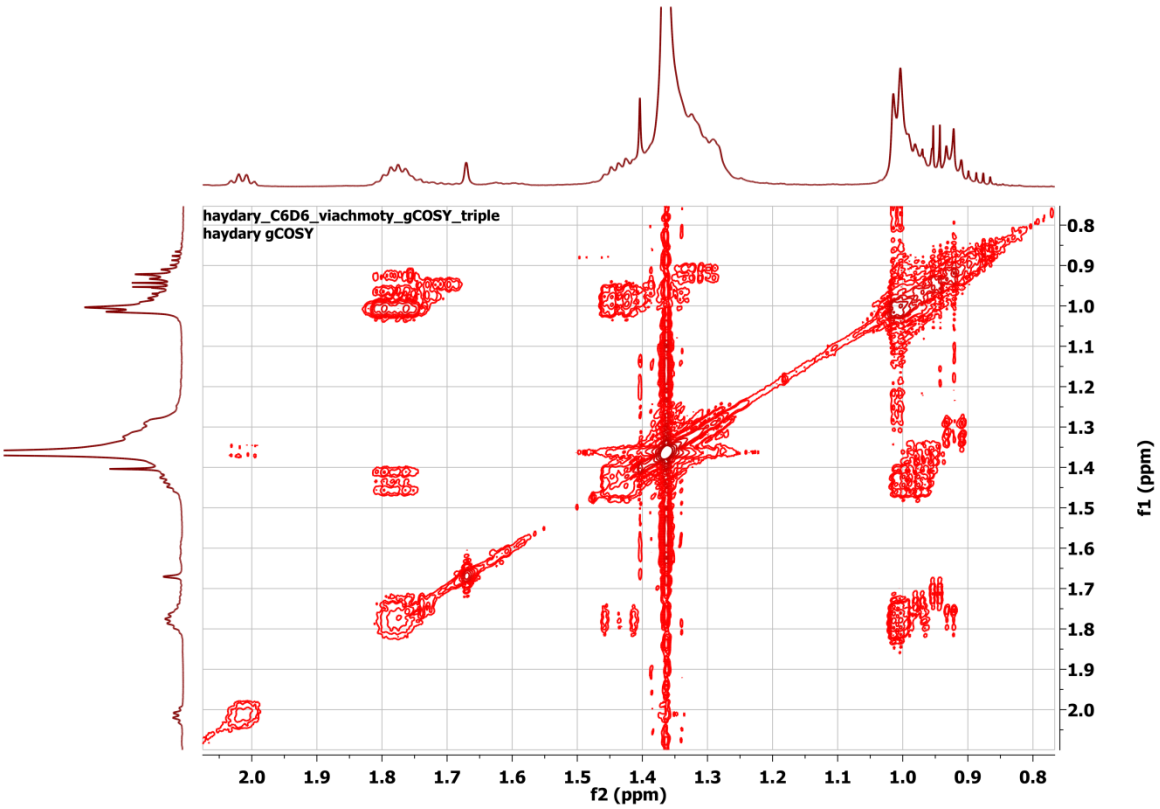

Figure NMR4. Homonuclear correlations of aliphatic protons in a zoom of the 2D COSY NMR spectrum of the liquid state sample

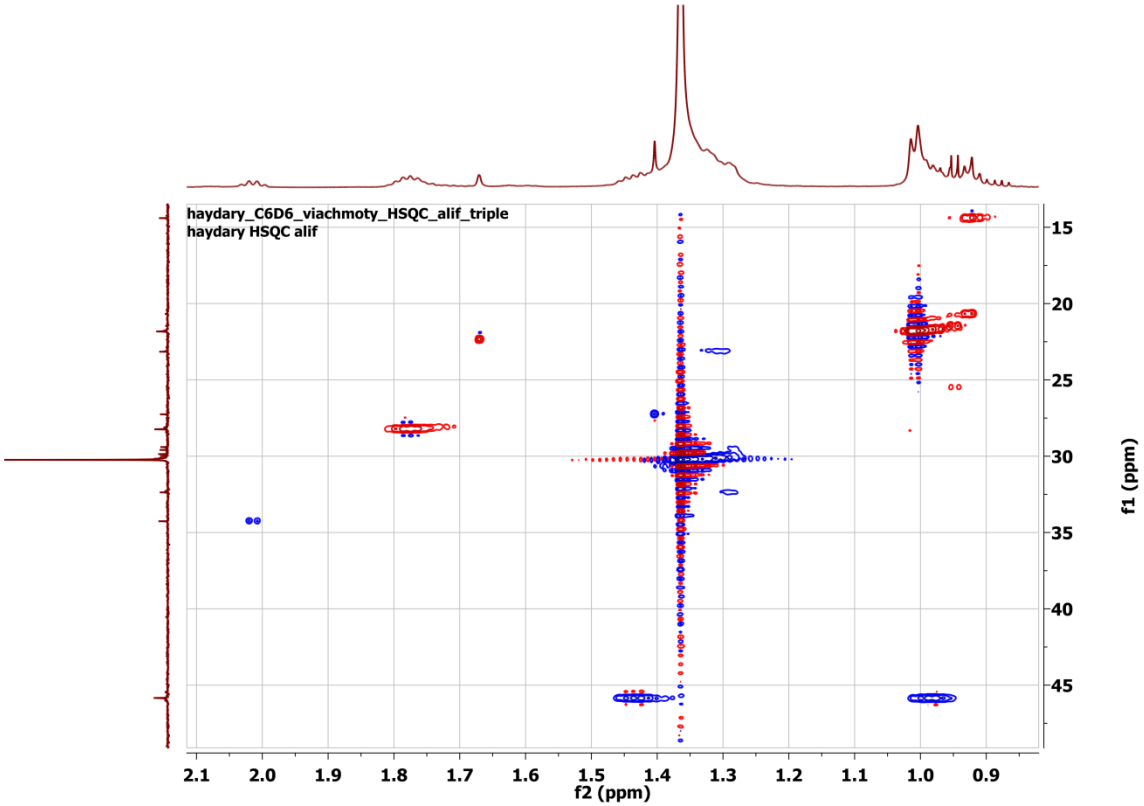

Figure NMR5. 2D HSQC NMR spectrum from the aliphatic chemical shift regions of ^{1}H and ^{13}C

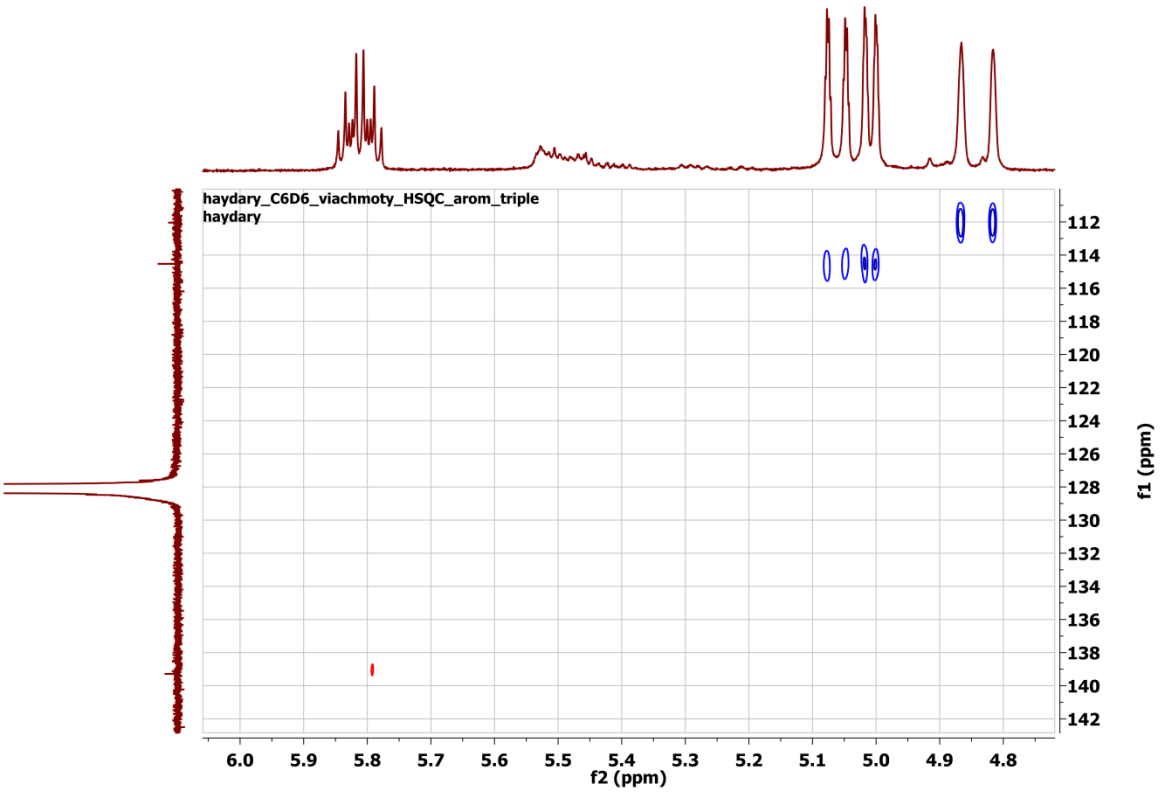

Figure NMR6. 2D HSQC NMR spectrum from the double-bond chemical shift regions of ^{1}H and ^{13}C

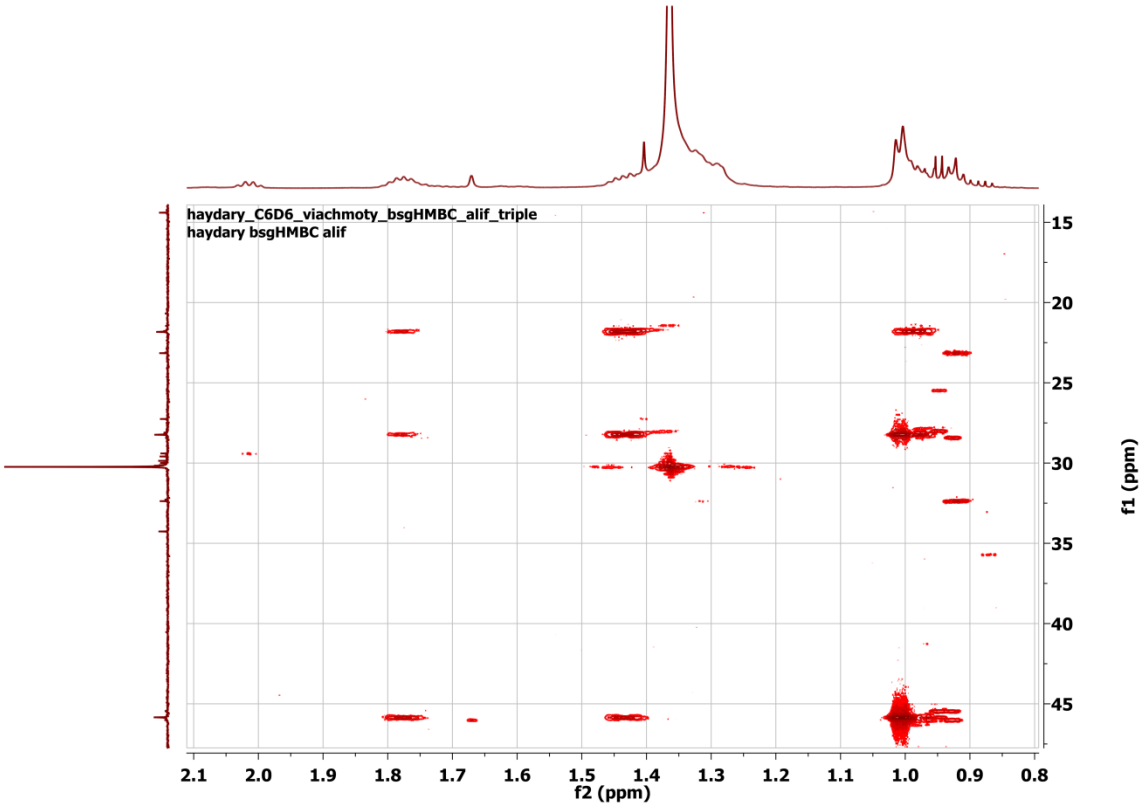

Figure NMR7. Band-selective gHMBC NMR spectrum from the aliphatic chemical shift regions of ^{1}H and ^{13}C.

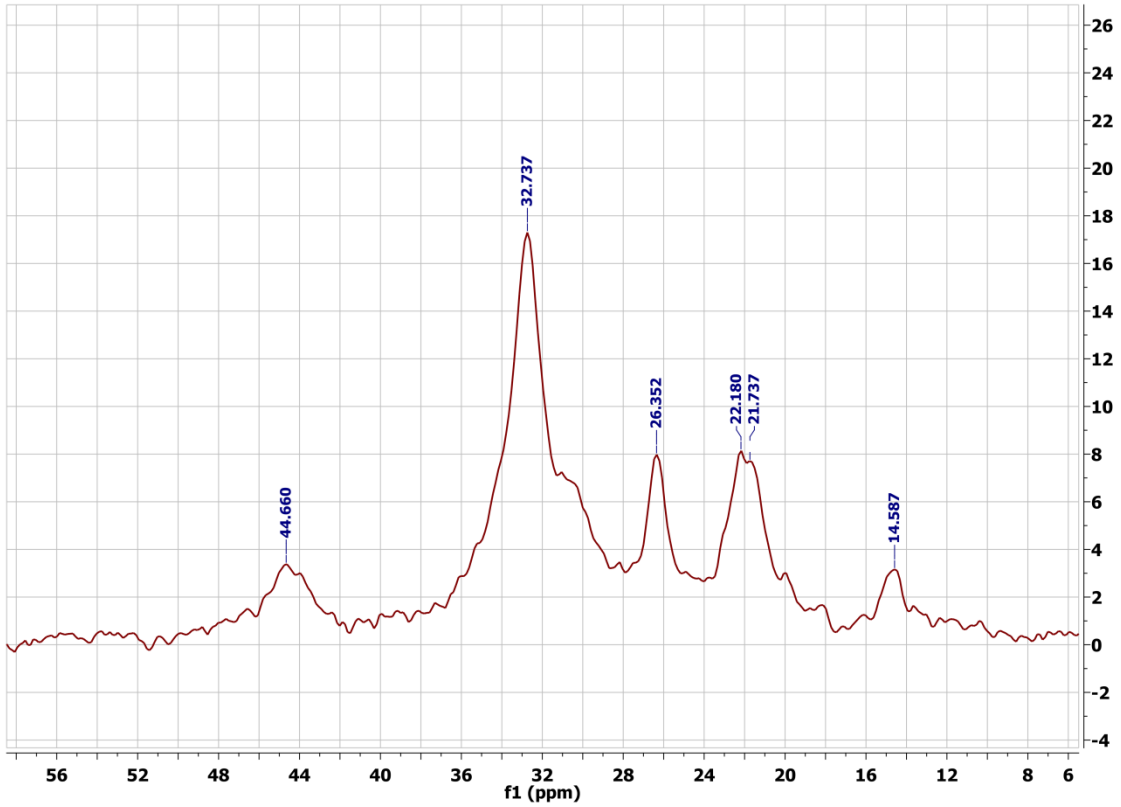

Figure NMR8. Directly measured solid state magic angle spinning (7 kHz spin rate) ^{13}C NMR spectrum of the sample

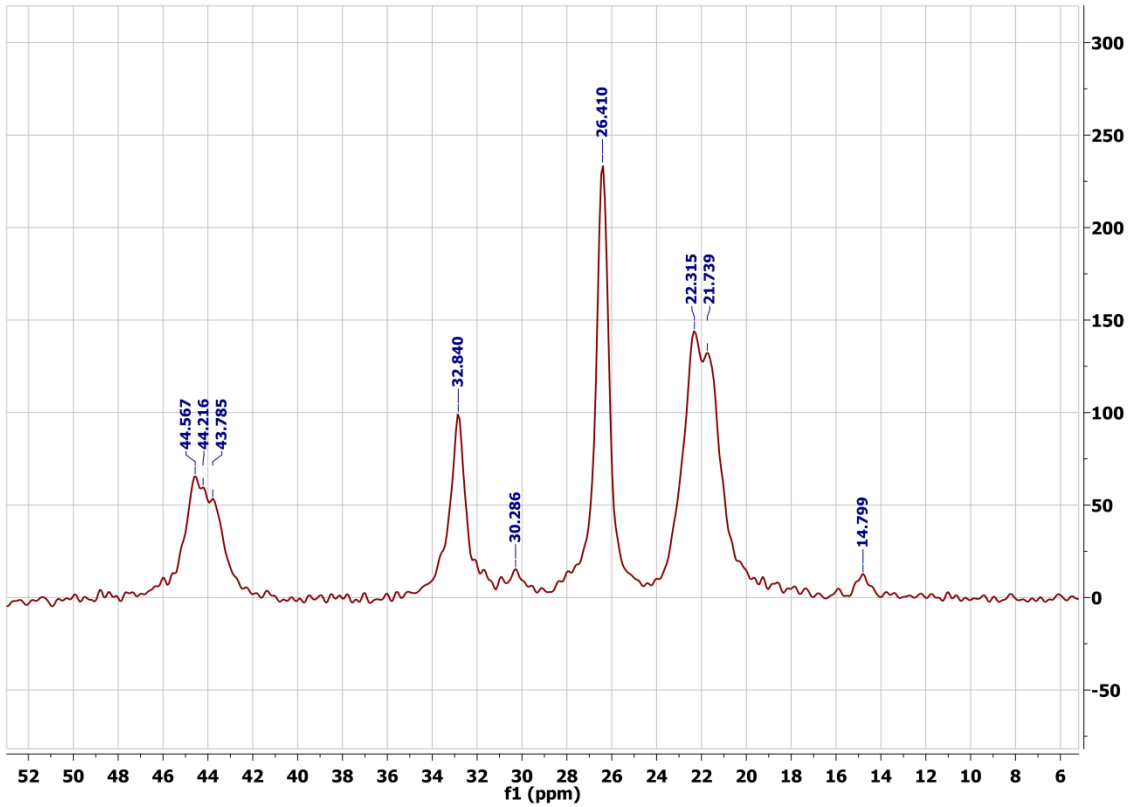

Figure NMR9. Solid state magic angle spinning (7 kHz spin rate) ^{13}C NMR spectrum with ^{1}H-^{13}C crosspolarization