

Electronic Supporting Information

Solid-State NMR as versatile tool to identify the main chemical components of epoxy-based thermosets

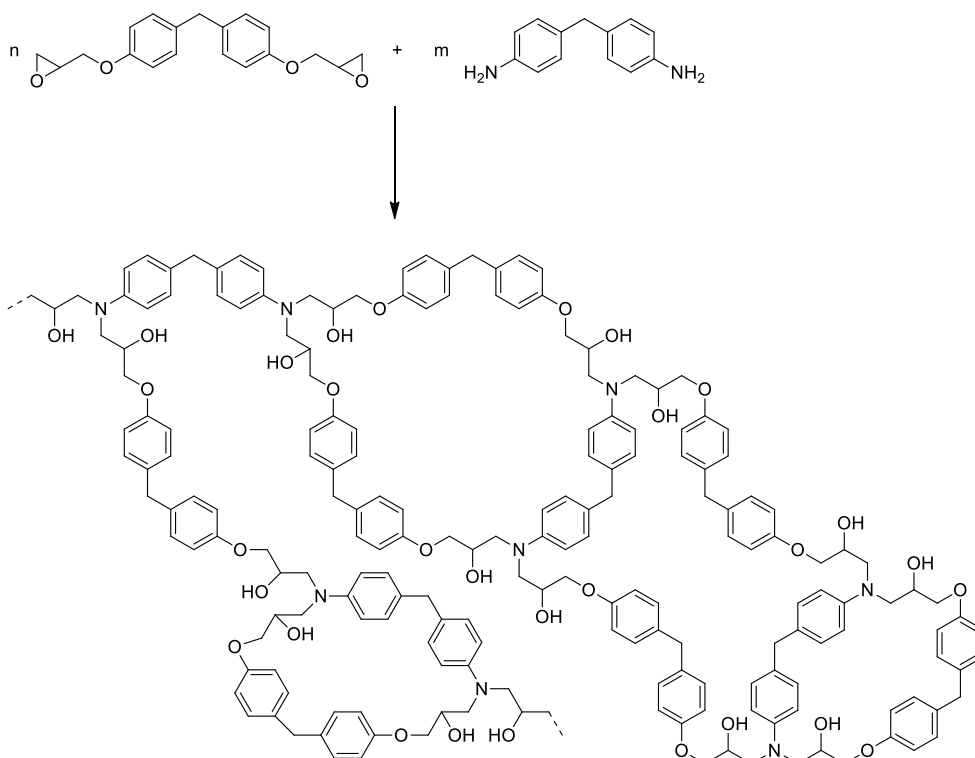
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Scheme S1: Exemplary structural section of a crosslinked epoxy resin.

Table S1: ^{13}C chemical shifts of the epoxy resins DGEBA and DGEBF part in the cross linked systems and assignments of these signals.

DGEBA		DGEBF	
chemical shift	structure	chemical shift	structure
157.1 ppm	1: $-\text{C}_q(\text{arom.})-\text{O}-$	157.1 ppm	1: $-\text{C}_q(\text{arom.})-\text{O}-$
144.0 ppm	4: $-\text{C}_q(\text{arom.})-\text{C}_q(\text{CH}_3)_2$	130.8 ppm	4: $-\text{C}_q(\text{arom.})-\text{CH}_2-$
128.2 ppm	3: $-\text{CH}(\text{arom.})-\text{C}_q(\text{arom.})-\text{C}_q(\text{CH}_3)_2$	121.2 ppm	3: $-\text{CH}(\text{arom.})-\text{C}_q(\text{arom.})-\text{CH}_2-$
117.7 ppm	2: $-\text{O}-\text{C}_q(\text{arom.})-\text{CH}(\text{arom.})-$	114.8 ppm	2: $-\text{O}-\text{C}_q(\text{arom.})-\text{CH}(\text{arom.})-$
70.4 ppm	7, 8: $-\text{O}-\text{CH}_2-\text{CH}-; -\text{CH}-\text{OH}$	70.4 ppm	6, 7: $-\text{O}-\text{CH}_2-\text{CH}-; -\text{CH}-\text{OH}$
61.8 ppm	9: $-\text{CH}-\text{CH}_2-\text{NR}_2$	61.8 ppm	8: $-\text{CH}-\text{CH}_2-\text{NR}_2$
41.9 ppm	5, 10: $-\text{C}_q(\text{CH}_3)_2$	37.7 ppm	5, 9: $-\text{C}_q(\text{arom.})-\text{CH}_2-\text{C}_q(\text{arom.})-$
31.6 ppm	6: $-\text{C}_q(\text{CH}_3)_2$		

DGEBA + TETA

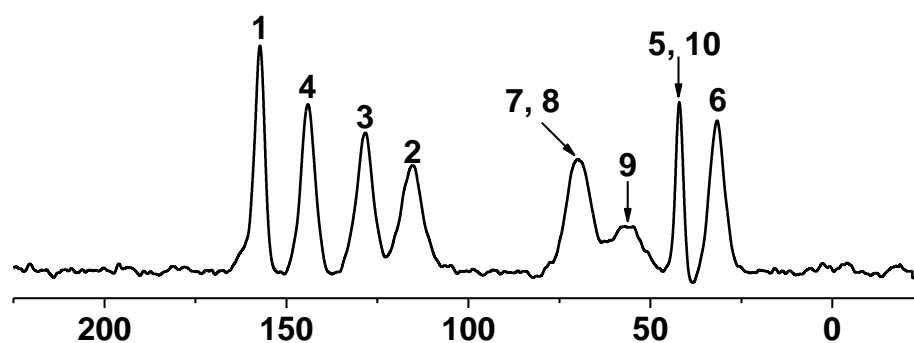


Figure S1. $^1\text{H}\rightarrow^{13}\text{C}$ CP MAS NMR spectrum of a sample containing the epoxy component DGEBA and the hardening agent TETA (see Figure 1a in the manuscript). Assignments of the signals are given in Table S1.

DGEBF + TETA

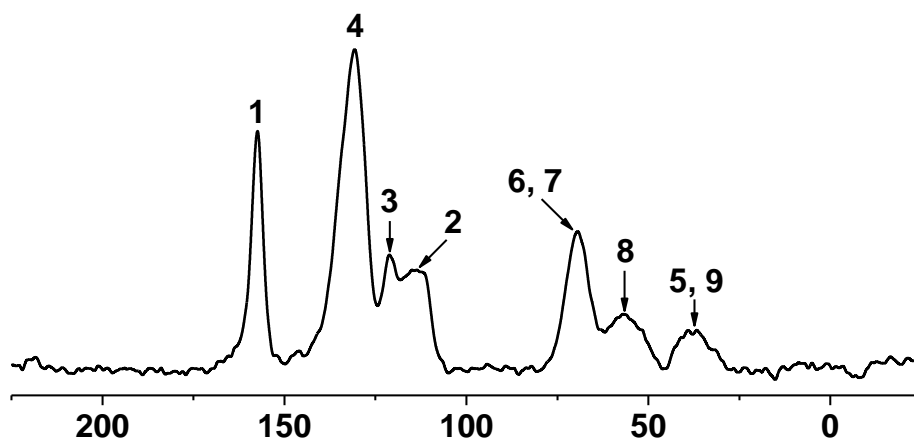


Figure S2. $^1\text{H} \rightarrow ^{13}\text{C}$ CP MAS NMR spectrum of a sample containing the epoxy component DGEBF and the hardening agent TETA. (see Figure 1f in the manuscript). Assignments of the signals are given in Table S1.

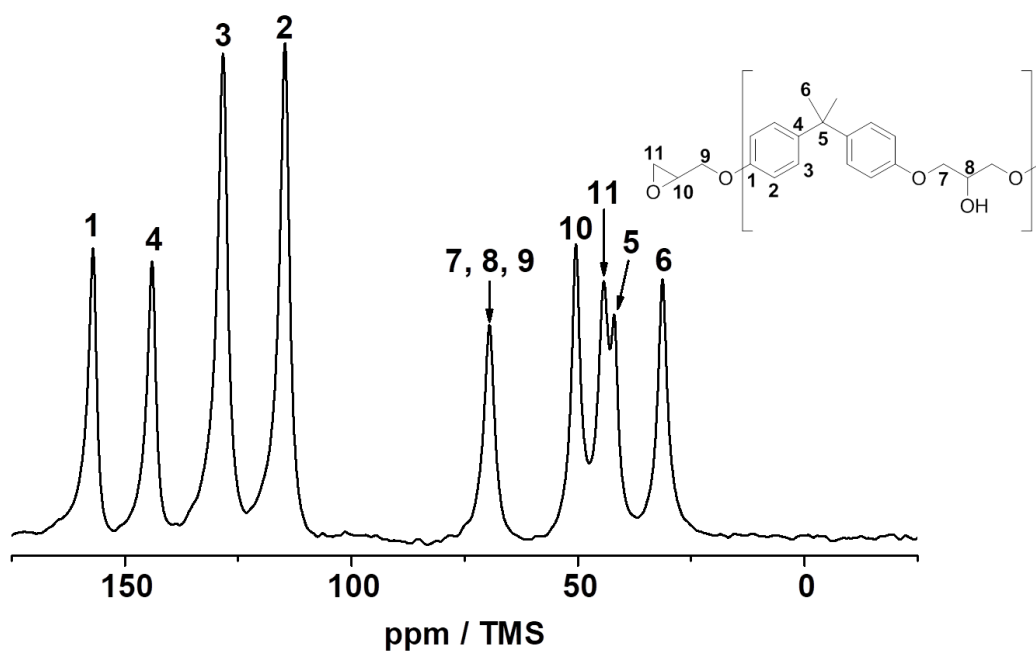


Figure S3. Direct excitation ^{13}C NMR spectrum and corresponding structure of the pure epoxy resin DGEBA.

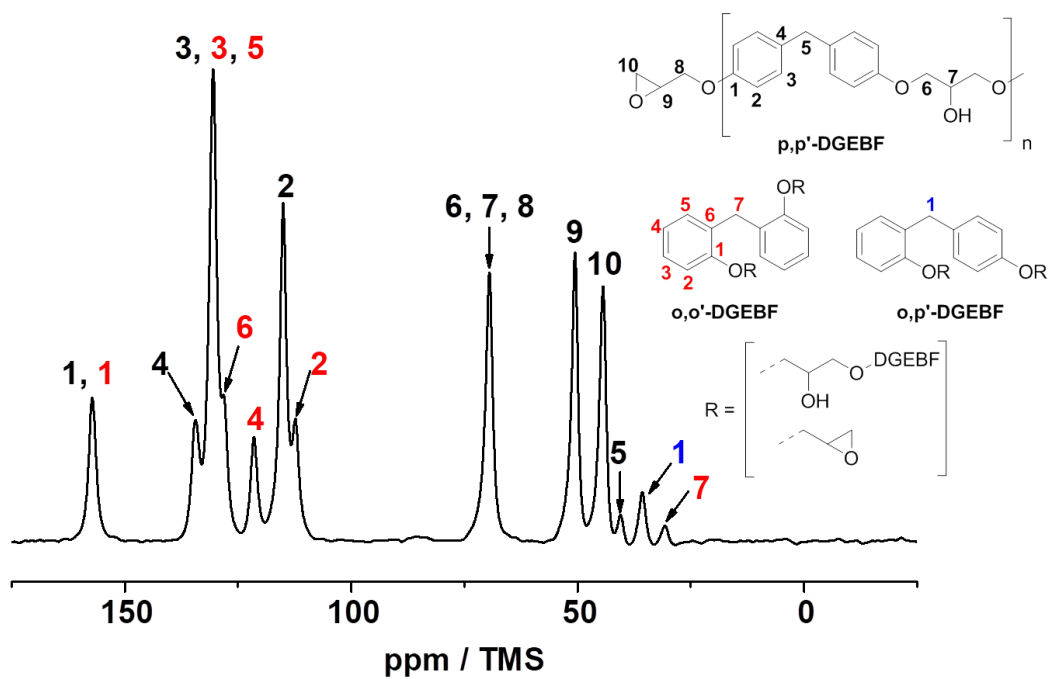


Figure S4. Direct excitation ^{13}C NMR spectrum and corresponding structure of the pure isomeric epoxy resin DGEBF.

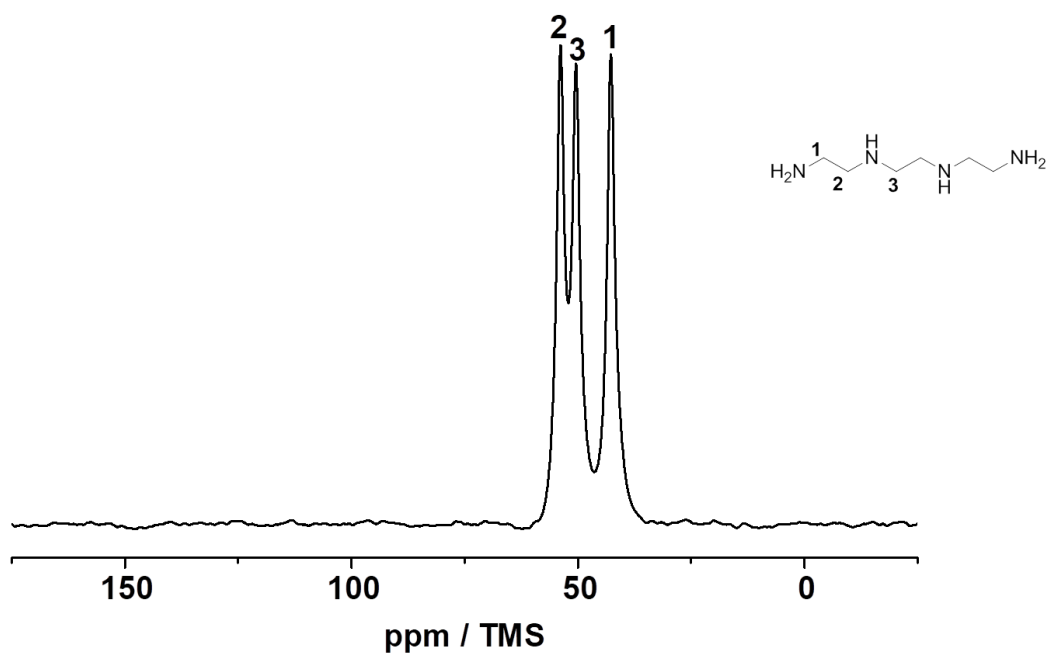


Figure S5. Direct excitation ^{13}C NMR spectrum and corresponding structure of the pure amine containing hardening agent TETA.

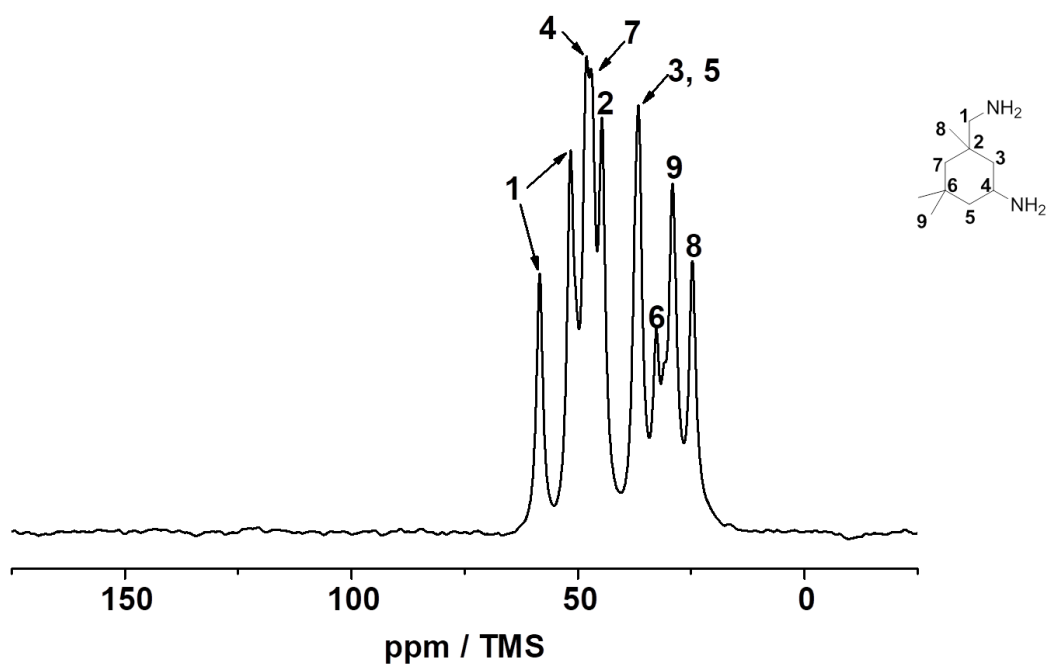


Figure S6. Direct excitation ^{13}C NMR spectrum and corresponding structure of the pure amine containing hardening agent IPDA.

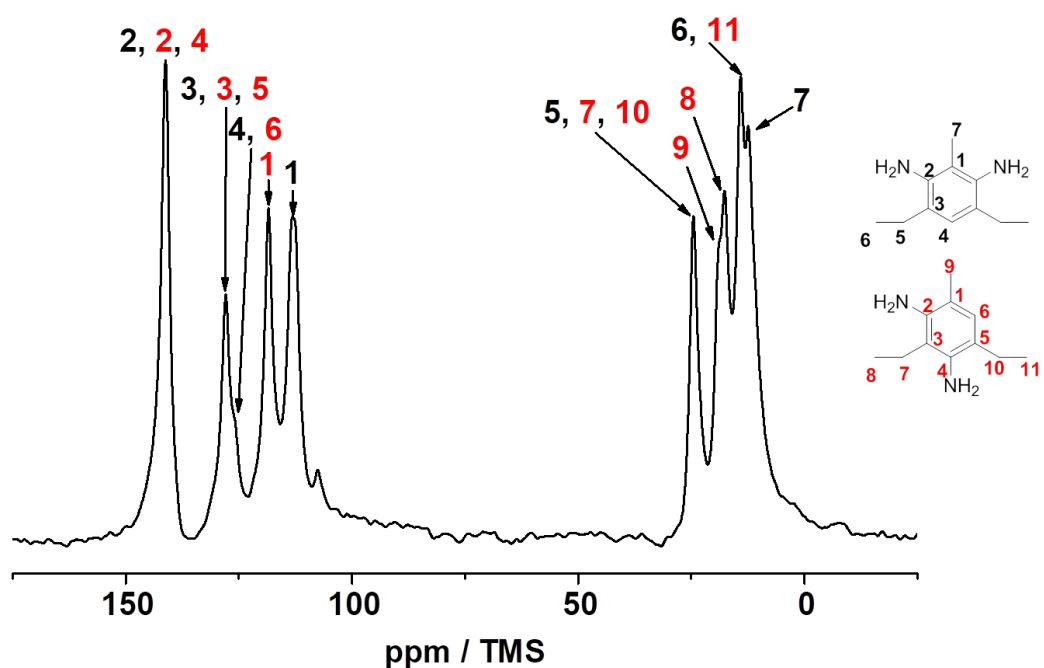


Figure S7. Direct excitation ^{13}C NMR spectrum and corresponding structure of the pure amine containing hardening agent DETDA80. Note: The small signal at about 107.5 ppm cannot be assigned to structural elements of DETDA80. It may refer to a by-product of the synthesis of DETDA80.

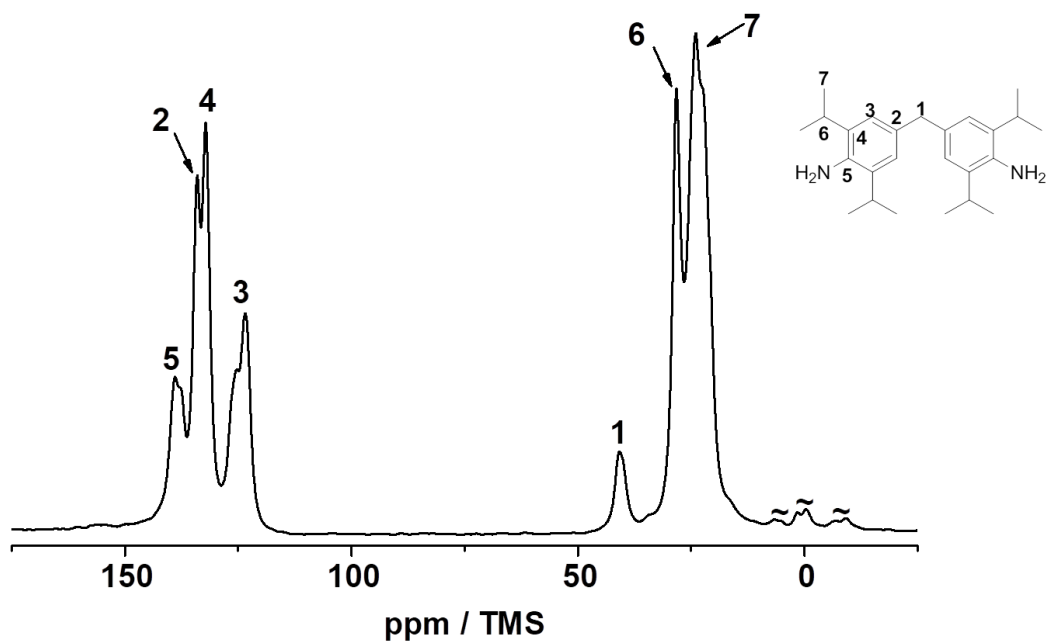


Figure S8. $^1\text{H} \rightarrow ^{13}\text{C}$ CP MAS NMR spectrum and corresponding structure of the pure amine containing hardening agent M-DIPA. Signals marked with ~ are spinning sidebands.

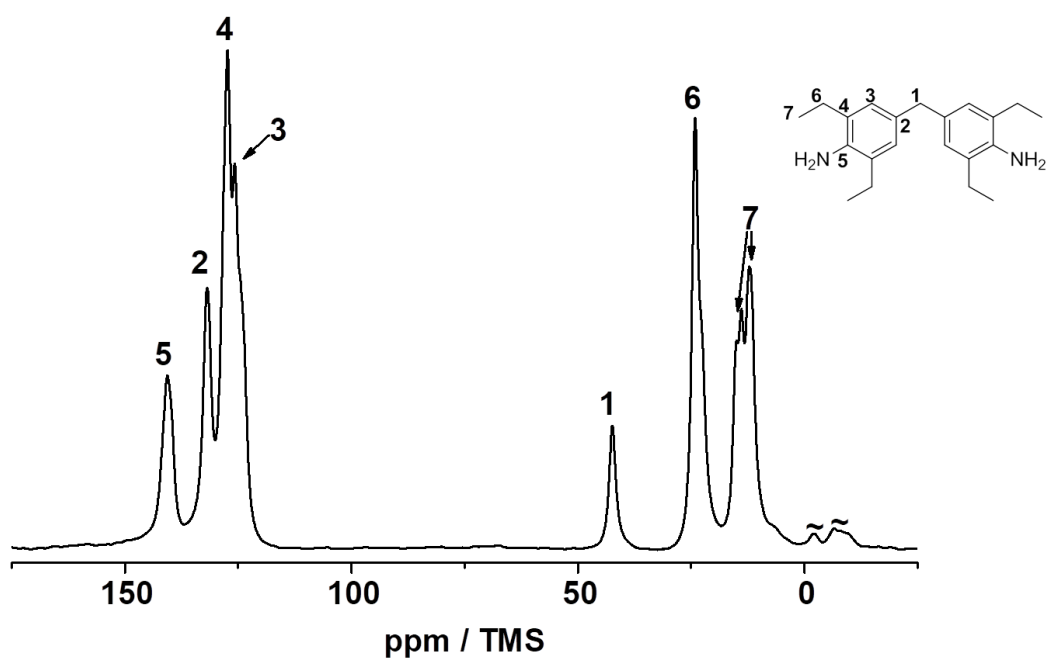


Figure S9. $^1\text{H} \rightarrow ^{13}\text{C}$ CP MAS NMR spectrum and corresponding structure of the pure amine containing hardening agent M-DEA. Note: Signals marked with ~ are spinning sidebands.

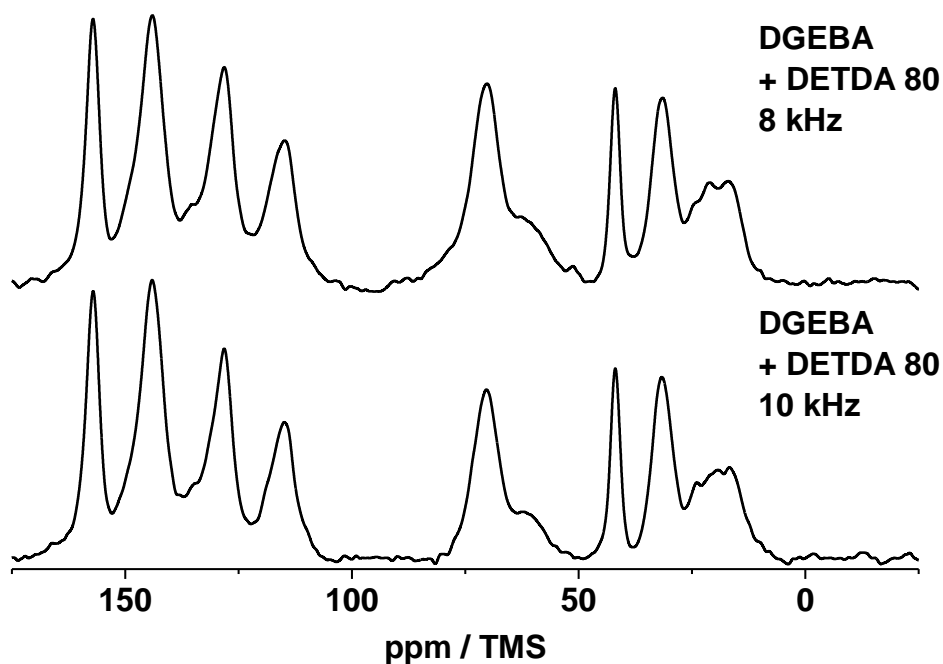


Figure S10. $^1\text{H} \rightarrow ^{13}\text{C}$ CP MAS NMR spectra of samples containing the epoxy resin DGEBA and the curing agent DETDA 80 at two different spinning rates.

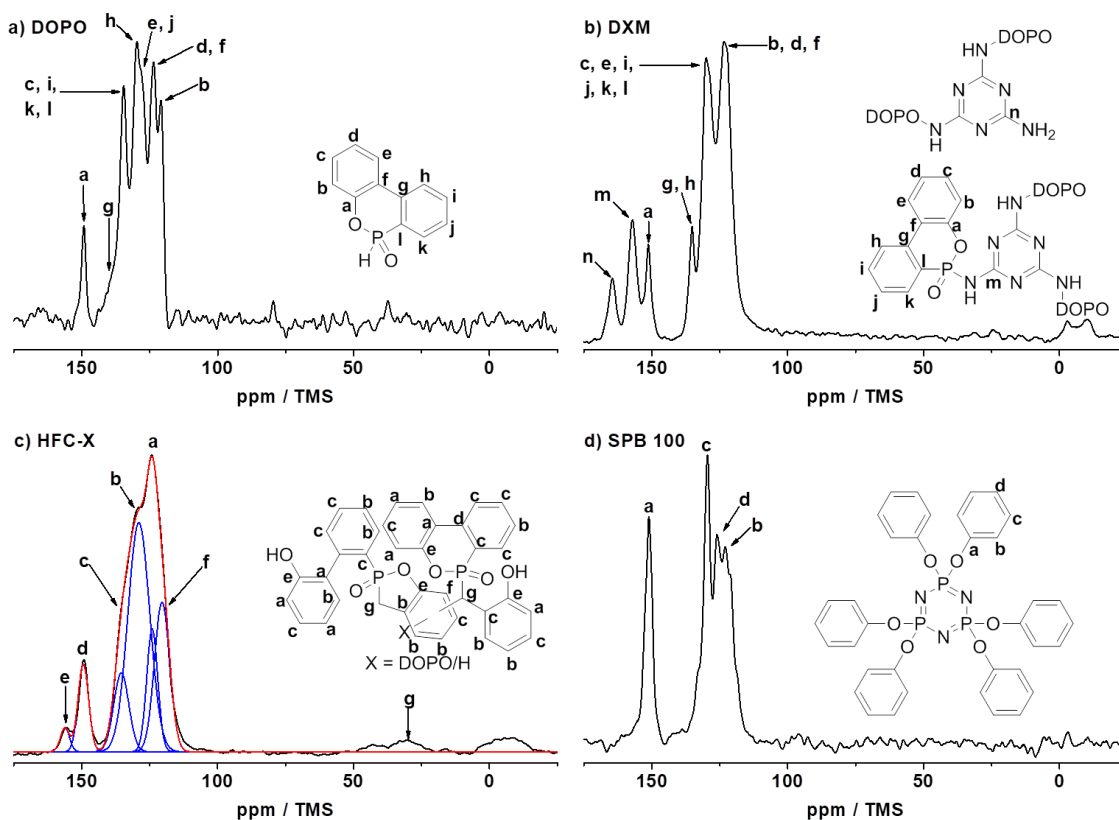


Figure S11. $^1\text{H} \rightarrow ^{13}\text{C}$ CP MAS NMR spectra of the phosphorus containing flame retardants DOPO (a), DXM (b), HFC-X (c) and SPB 100 (d).

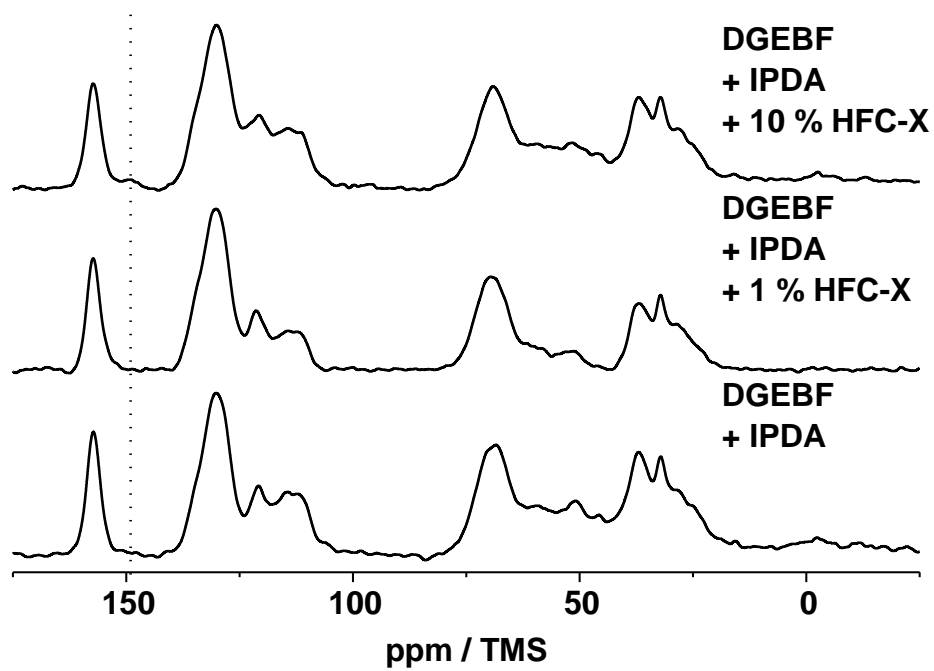


Figure S12. $^1\text{H} \rightarrow ^{13}\text{C}$ CP MAS NMR spectra of samples containing DGEBA cured with IPDA and different amounts of the flame retardant HFC-X.

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