Supporting Information

for

Side-Chain Poly(phosphoramidate)s via Acyclic Diene Metathesis Polycondensation

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1. NMR-spectra

Fig. S1: $^1$H NMR spectrum of 1 (298K, 300 MHz in DMSO-$d_6$).

Fig. S2. $^{31}$P NMR spectrum of 1 (298K, 202 MHz in DMSO-$d_6$).
Fig. S3. $^{13}$C NMR spectrum of 1 at (298 K, 125 MHz in DMSO-$d_6$).
**Fig. S4.** $^1$H$^{15}$N HMBC spectrum of 1 (298K, 710 MHz in DMSO-$d_6$). Cross relaxation between the $^{15}$N signal at 42.29 ppm with the neighboring protons can be observed. Cross relaxation is displayed between the $^{15}$N signal and the proton bound to the nitrogen atom at 4.75 ppm. The alpha (2.71 ppm) and beta (1.37 ppm) methylene groups to the amidate group show also cross relaxation.
**Fig. S5.** $^1$H NMR spectrum of P1 (298 K, 300 MHz in CDCl$_3$).

**Fig. S6.** $^{31}$P NMR spectrum of P1 (298 K, 202 MHz in CDCl$_3$).
Fig. S7. $^1$H NMR spectrum of 2 at (298 K, 300 MHz in CDCl$_3$).

Fig. S8. $^{31}$P NMR spectrum of 2 (298 K, 202 MHz in CDCl$_3$)
Fig. S 9. $^1$H NMR spectrum of P2 at (298 K, 300 MHz in CDCl$_3$).

Fig. S 10. $^{31}$P NMR spectrum of P2 at (298 K, 202 MHz in CDCl$_3$).
Fig. S11. $^1$H NMR spectrum of P1-H at (298 K, 300 MHz in CDCl$_3$).

Fig. S12. $^1$H NMR spectrum of P2-H at (298 K, 300 MHz in CDCl$_3$).
Fig. S13. $^{31}$P NMR spectrum after side-chain cleavage of P1 at (298 K, 121.5 MHz in CDCl$_3$).
2. GPC-data

Fig. S 14. Representative GPC elugrams of P1 with different catalyst loadings prepared by ADMET polycondensation.
**Fig. S15.** Representative GPC elugram of Poly2 prepared by ADMET polycondensation.

**Fig S16:** Overlay of SEC elugrams of P1 before and after hydrogenation.

Bulk properties
**Fig. S17.** TGA thermograms of P1 and P2.

**Figure S18.** DSC thermograms of (a) P1 (black) and P1-H (red). (b) P2 (green) and P2-H (blue). Both experiments were performed at a heating/cooling rate of 10°C/min.
**Figure S19:** TEM micrograph and the corresponding diffraction pattern of solution crystallized P1-H.

**Figure S20:** TEM micrograph and the corresponding diffraction pattern (inset) of solution crystallized P2-H.

**Figure S21:** SAXS and WAXS measurements of P2-H samples. Prior to the x-ray measurement the sample was annealed at 42 °C for 24 hours.