

Electronic Supplementary Information

Efficient metal-free crosslinking for common propellant binders using nitrile oxide-alkene click ligation

Jinkang Dou,^a Lijie Cheng,^b Bojun Tan,^a Binghui Duan,^a Minghui Xu,^a Bozhou Wang^a
and Ning Liu^{a,*}

^a Department of Energetic Materials Science and Technology, Xi'an Modern Chemistry Research Institute, Xi'an 710065, China.

^b School of Energy and Power Engineering, Xi'an Jiaotong University, Xi'an 710049, China.

* Corresponding authors.

† Email: flackliu@sina.com

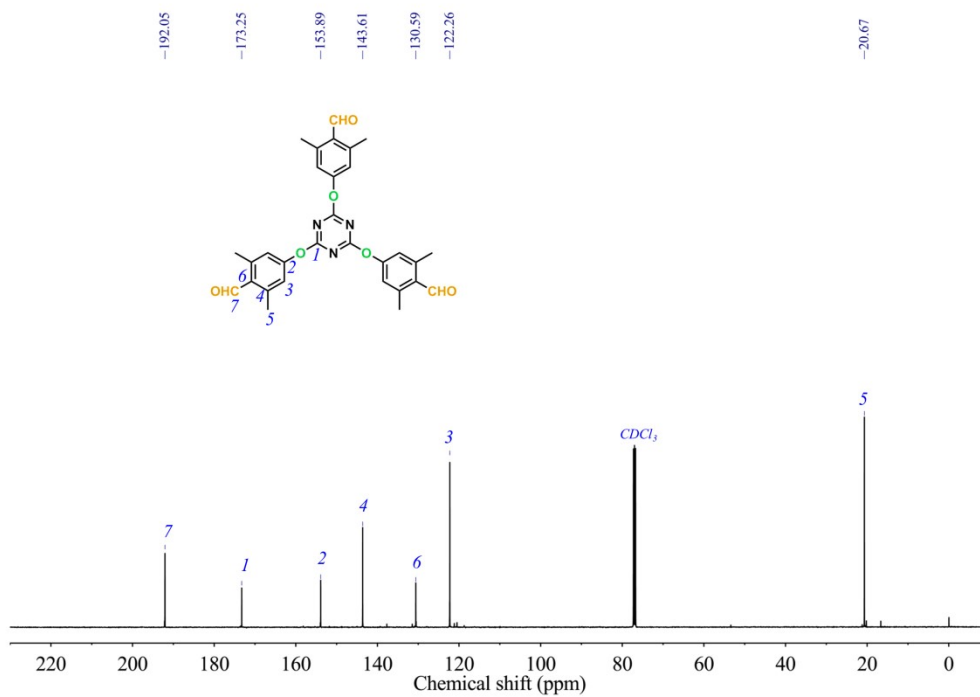


Figure S1. ^{13}C -NMR spectrum of trialdehyde in $CDCl_3$.

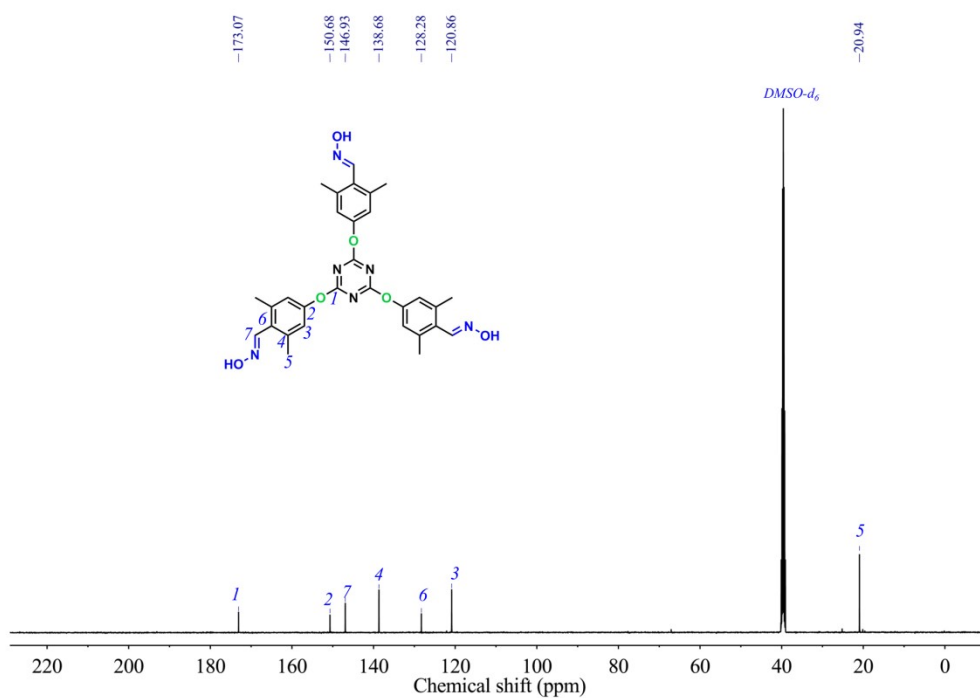


Figure S2. ^{13}C -NMR spectrum of trioxime in $DMSO-d_6$.

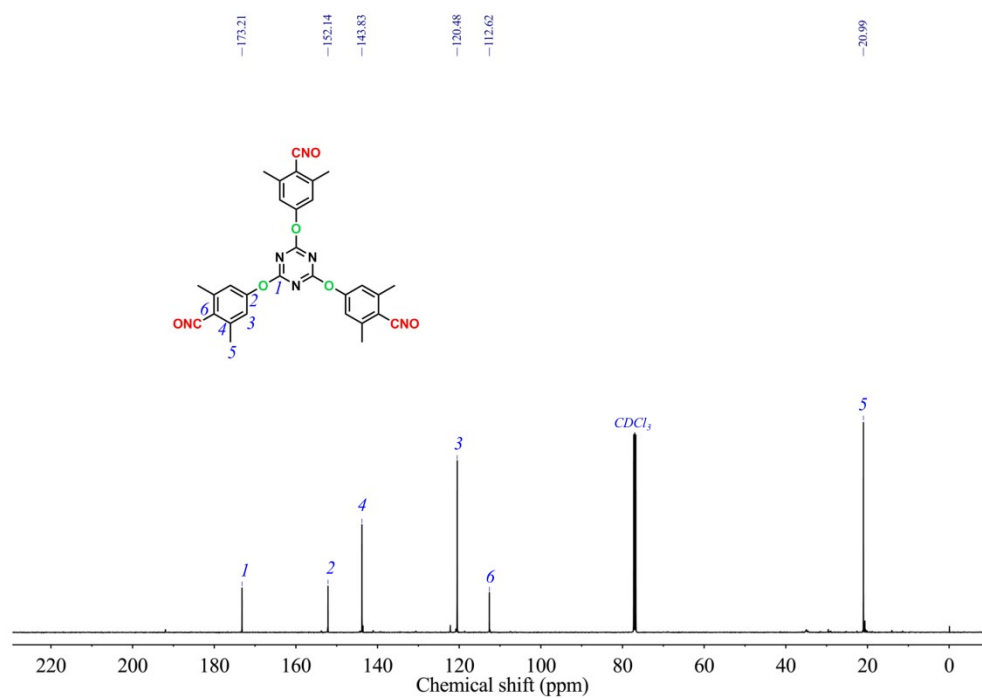


Figure S3. ¹³C-NMR spectrum of TNO in CDCl₃.

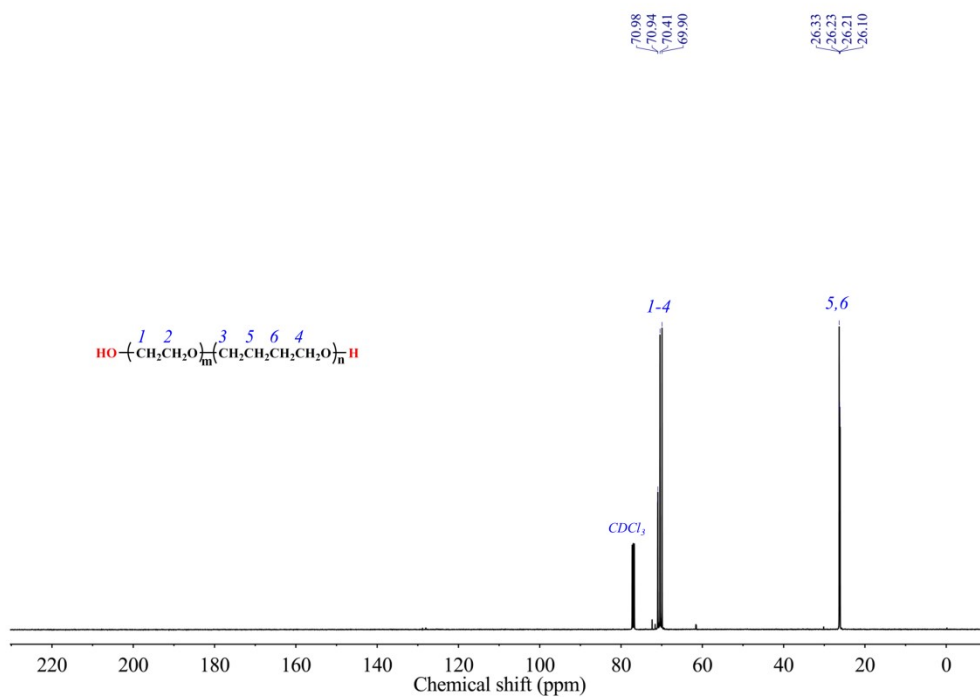


Figure S4. ¹³C-NMR spectrum of HTP in CDCl₃.

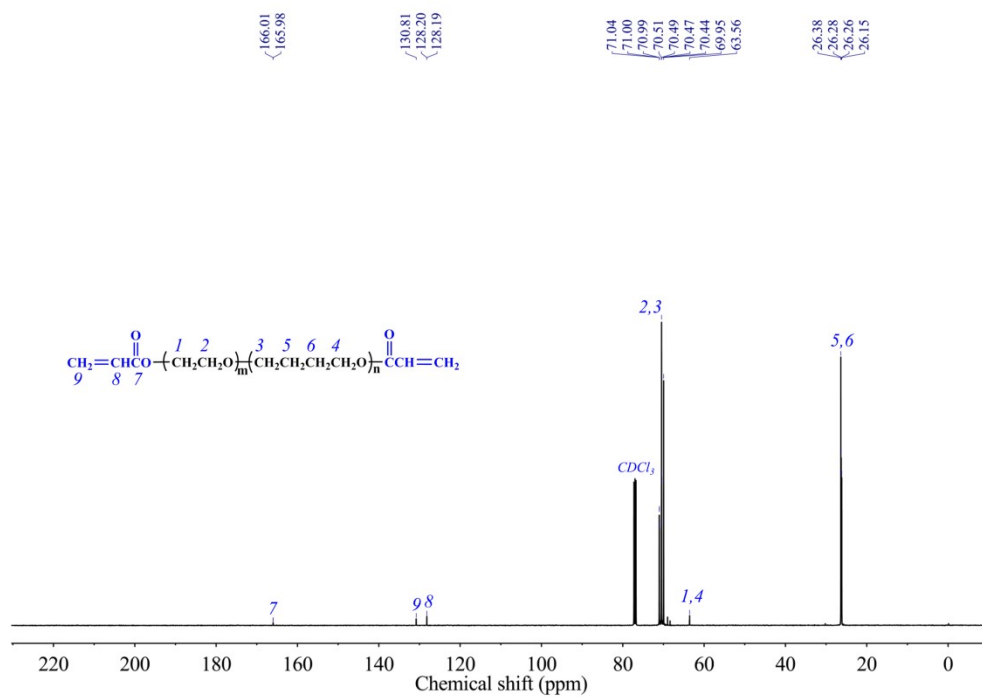


Figure S5. ^{13}C -NMR spectrum of ATPET-1 in CDCl_3 .

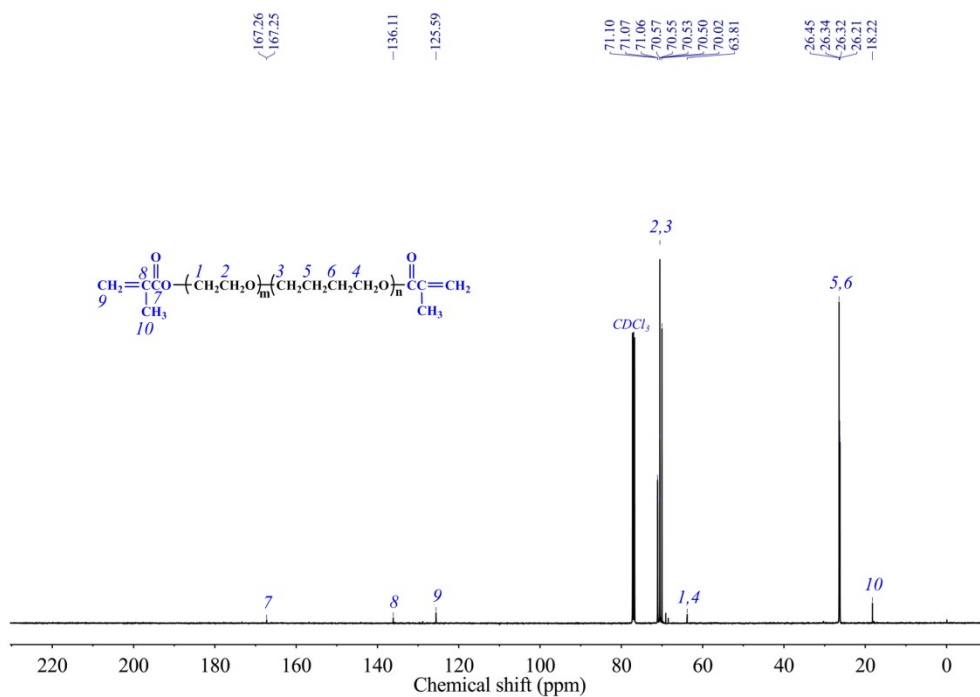


Figure S6. ^{13}C -NMR spectrum of ATPET-2 in CDCl_3 .

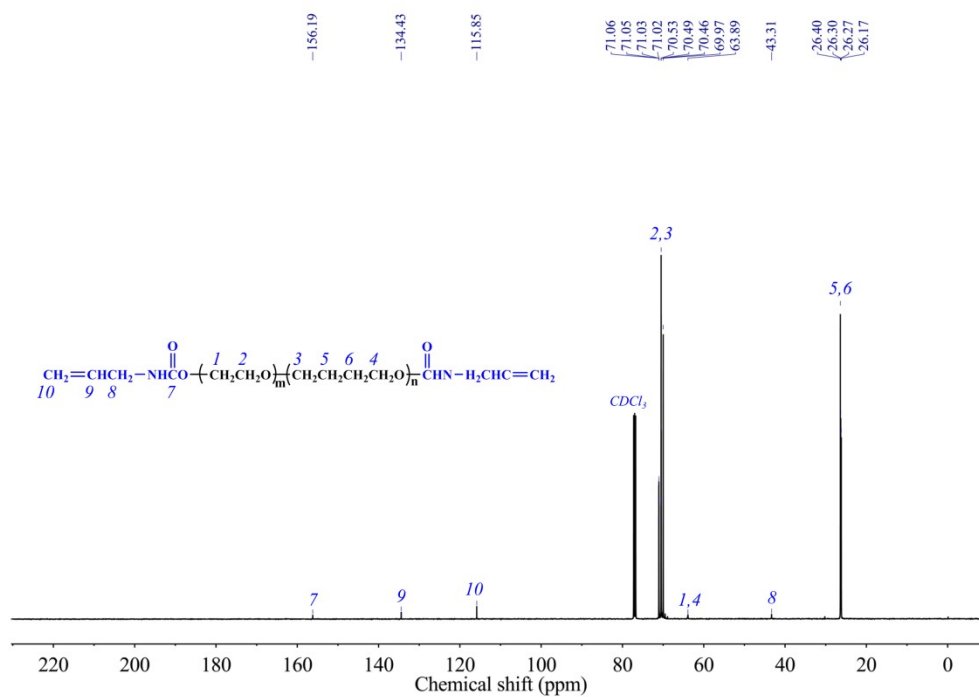


Figure S7. ^{13}C -NMR spectrum of ATPET-3 in CDCl_3 .

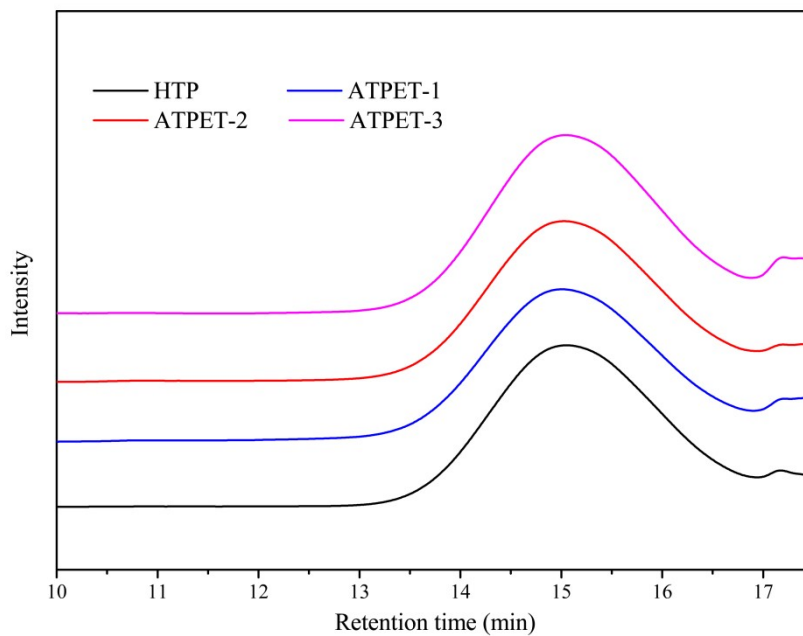


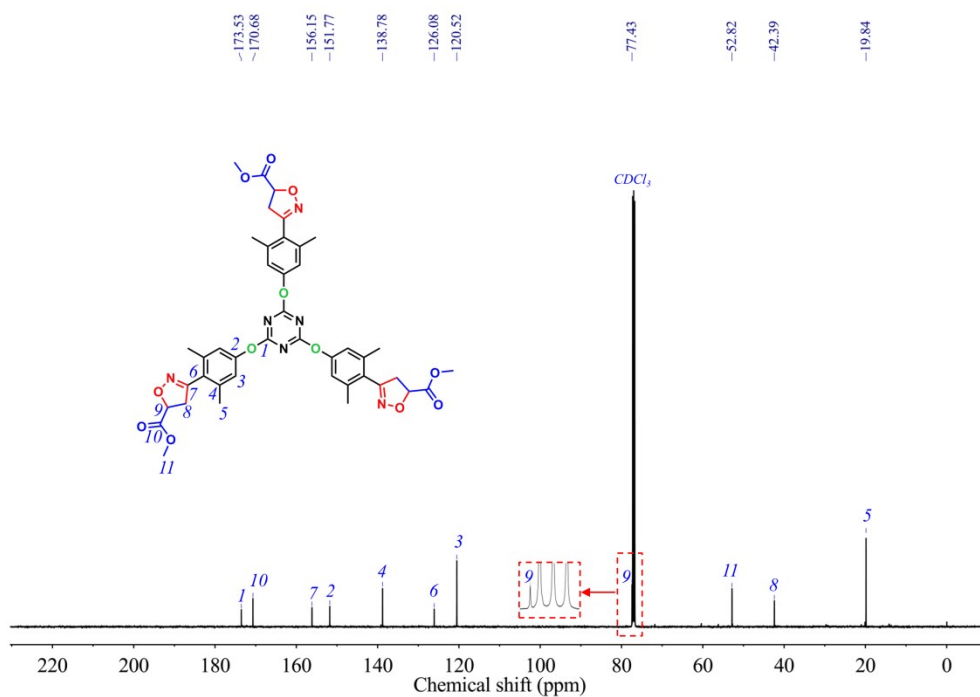
Figure S8. GPC curves of HTP (black line), ATPET-1 (blue line), ATPET-2 (red line) and ATPET-3 (magenta line).

Table S1. M_n and PDI of HTP, ATPET-1, ATPET-2 and ATPET-3.

Binder	HTP	ATPET-1	ATPET-2	ATPET-3
M_n (g·mol ⁻¹)	4894	5042	5557	4994
PDI	1.47	1.48	1.33	1.43

Table S2. Viscosity and T_g of HTP, ATPET-1, ATPET-2 and ATPET-3.

Binder	HTP	ATPET-1	ATPET-2	ATPET-3
Viscosity (Pa·s, 25°C)	16.09	16.98	16.15	17.22
T_g (°C)	-80.38	-79.79	-79.97	-79.78

**Figure S9.** ¹³C-NMR spectrum of isoxazoline products in CDCl₃ formed from TNO and methyl acrylate.

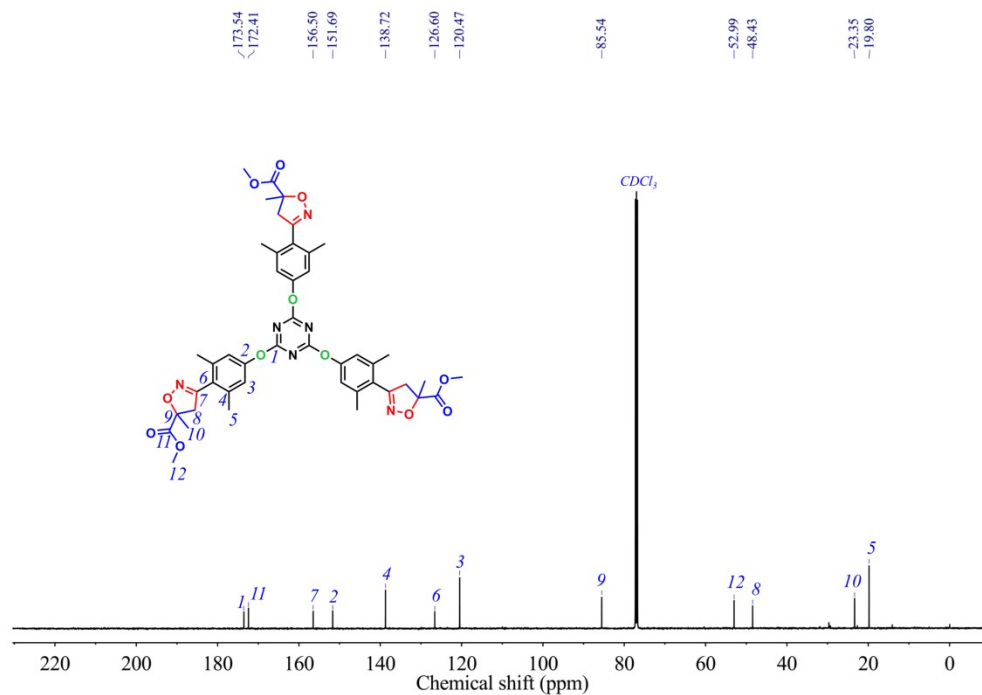


Figure S10. ^{13}C -NMR spectrum of isoxazoline products in $CDCl_3$ formed from TNO and methyl methacrylate.

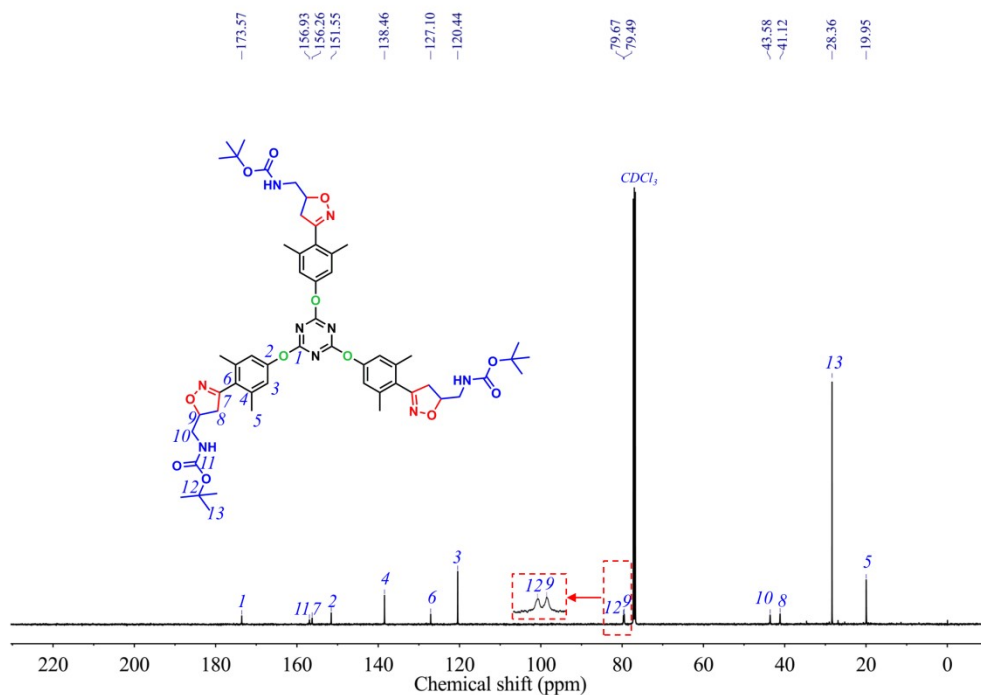


Figure S11. ^{13}C -NMR spectrum of isoxazoline products in $CDCl_3$ formed from TNO and *tert*-butyl allylcarbamate.

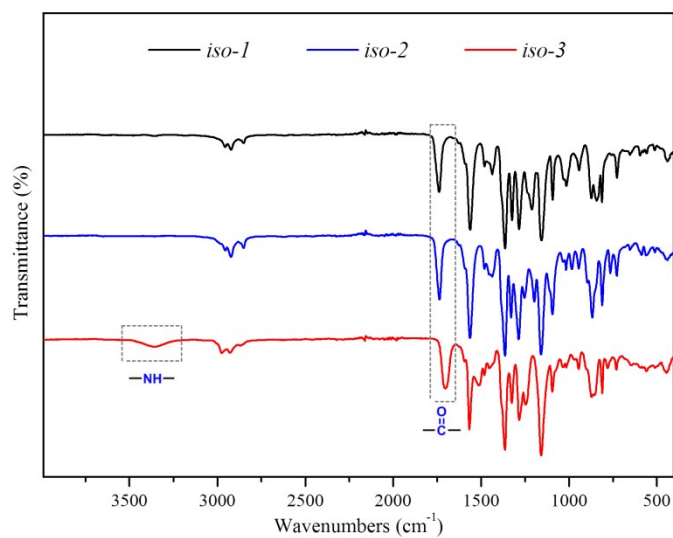


Figure S12. FTIR spectra of isoxazoline products formed from TNO with methyl acrylate (black line), methyl methacrylate (blue line) and *tert*-butyl allylcarbamate (red line), respectively.

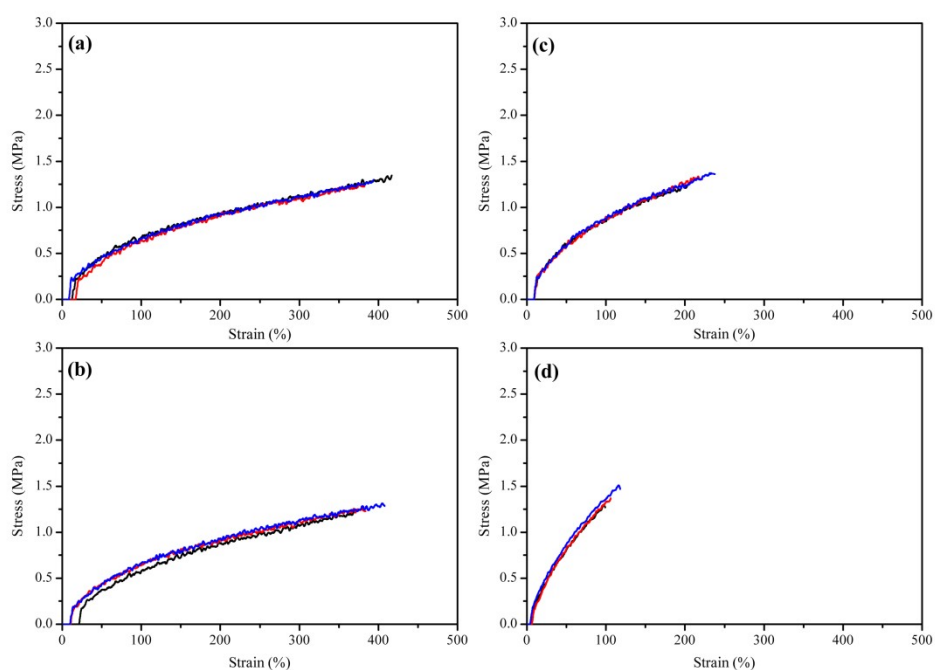


Figure S13. Stress-strain curves of elastomers formed from (a) ATPET-1/TNO, (b) ATPET-2/TNO, (c) ATPET-3/TNO and (d) HTP/N100.

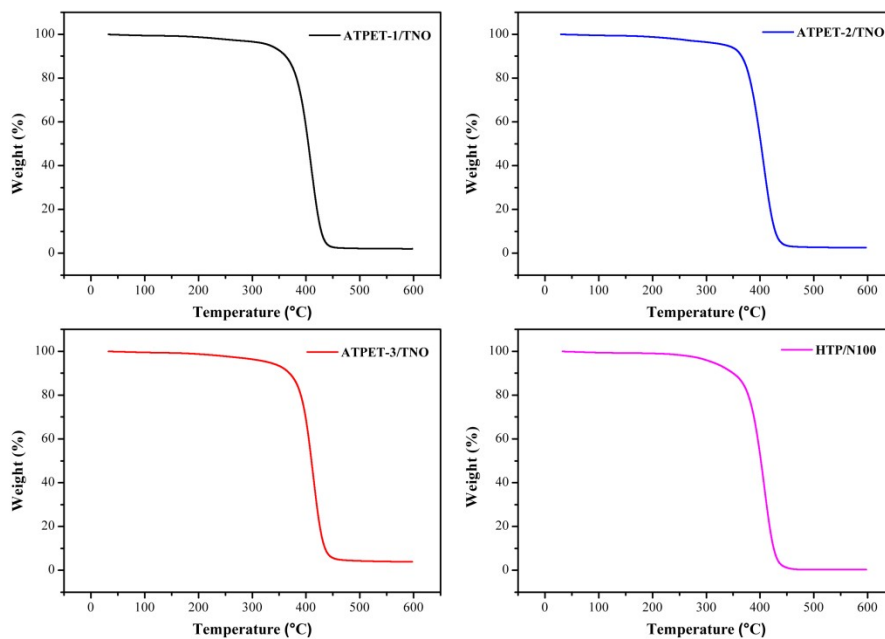


Figure S14. TG curves of elastomers formed from ATPET-1/TNO (black line), ATPET-2/TNO (blue line), ATPET-3/TNO (red line) and HTP/N100 (magenta line).

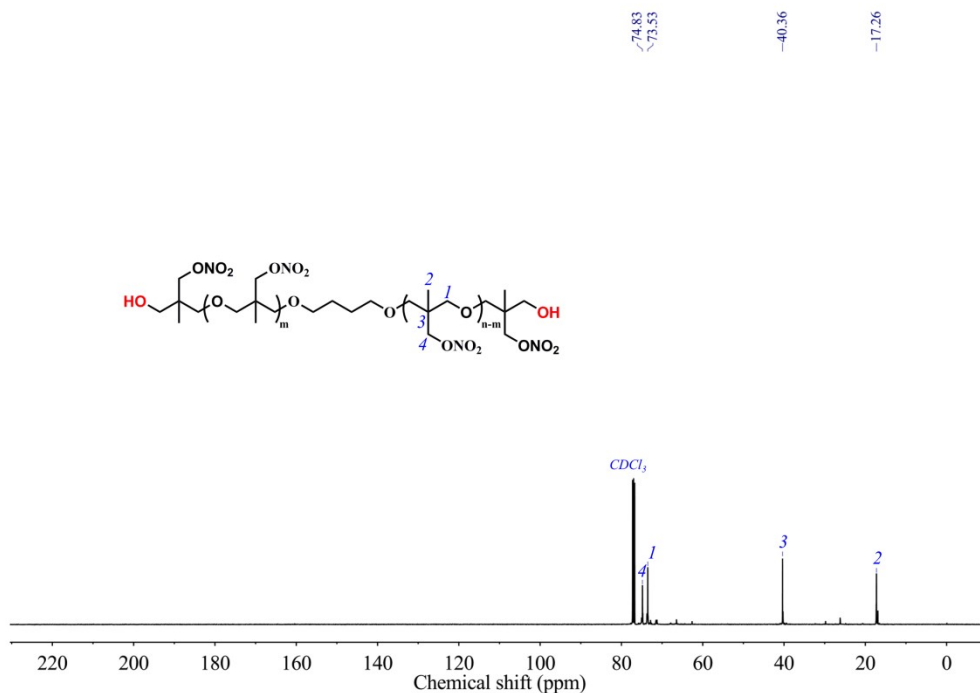


Figure S15. ^{13}C -NMR spectrum of PNIMMO in CDCl_3 .

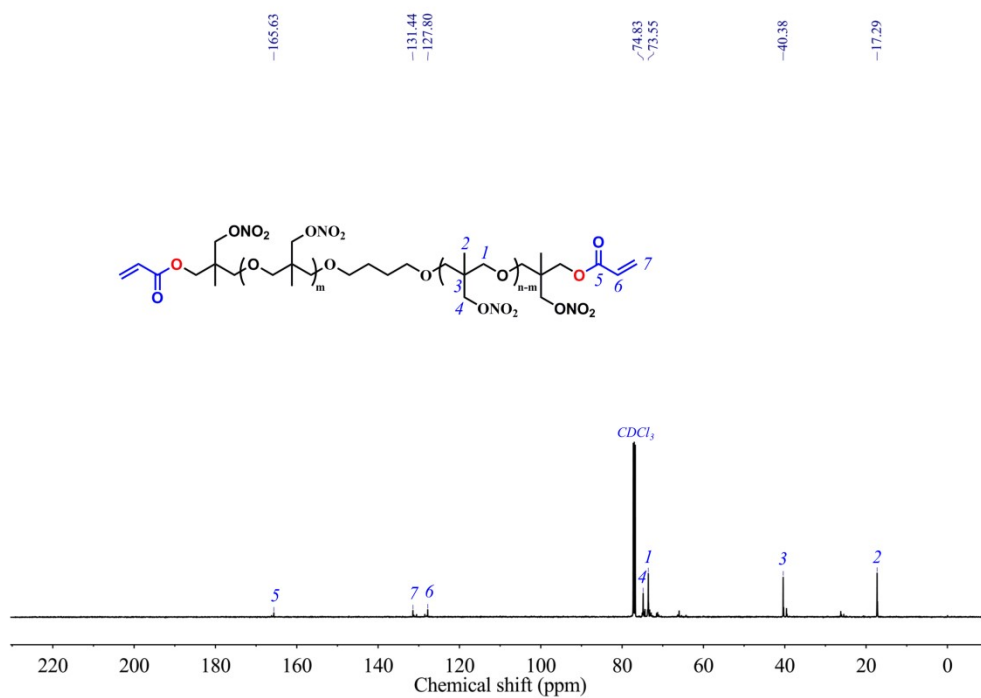


Figure S16. ¹³C-NMR spectrum of ATPNIMMO in CDCl₃.

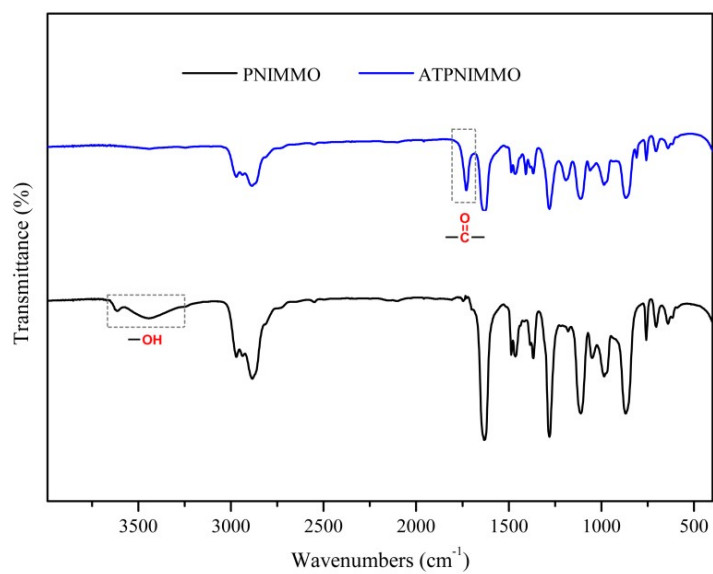


Figure S17. FTIR spectra of PNIMMO (black line) and ATPNIMMO (blue line).

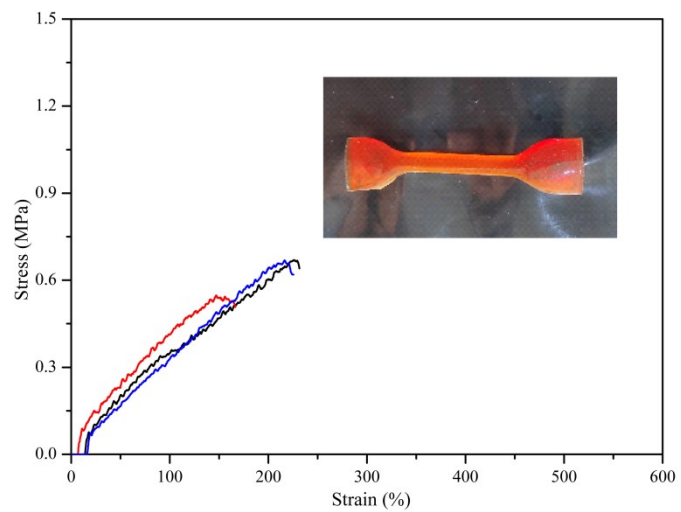


Figure S18. Stress-strain curves and photo of elastomers formed from ATPNIMMO/TNO.