

Supplementary Information

Preparation of Functionalized Diene-Elastomers upon Top-Down Pyrolysis of Vulcanizates via Dynamic Covalent Polymerization

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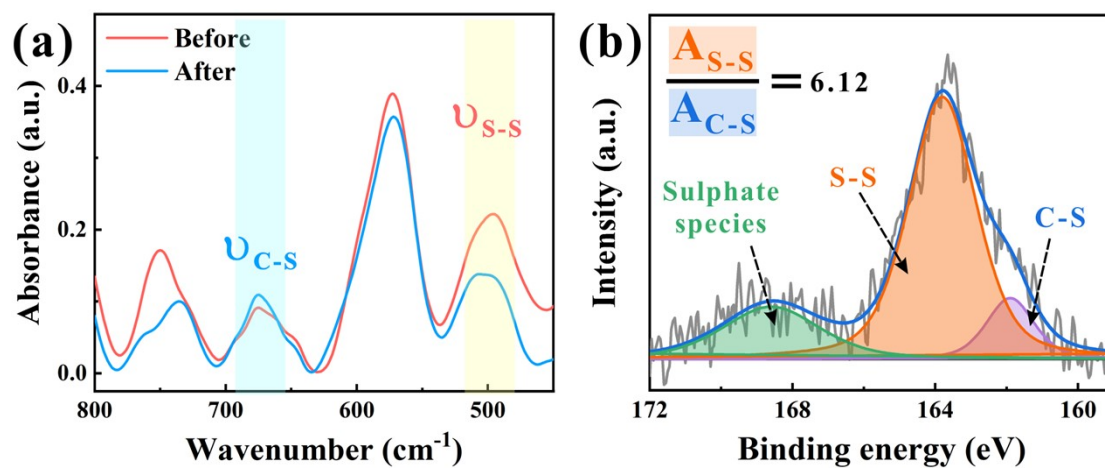


Figure S1. (a) FTIR spectra of HS-NR granules before and after selectively cleaving disulfide/polysulfide linkages. (b) High-resolution S2p spectrum of HS-NR granules.

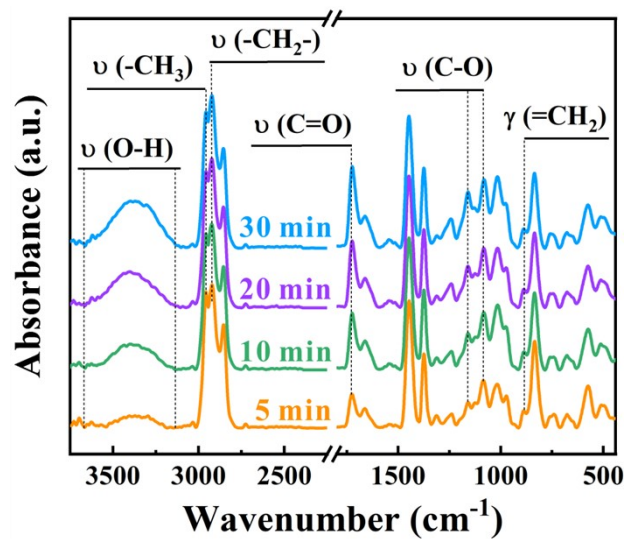


Figure S2. FTIR spectra of HM5-y-170 samples.

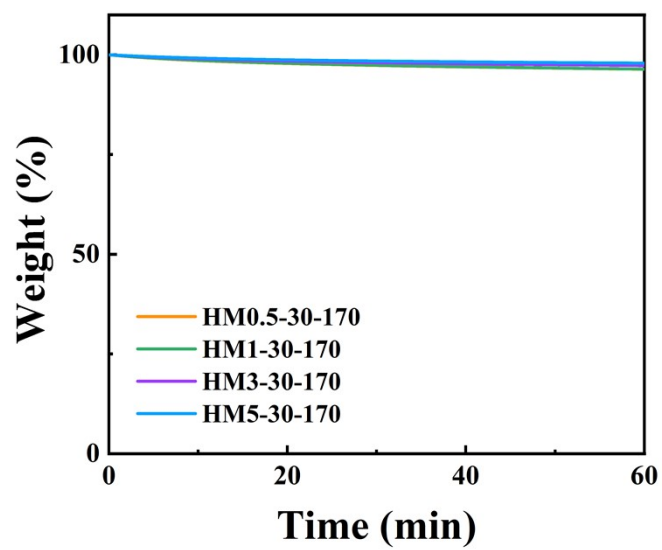


Figure S3. TGA profiles of HM x -30-170 samples

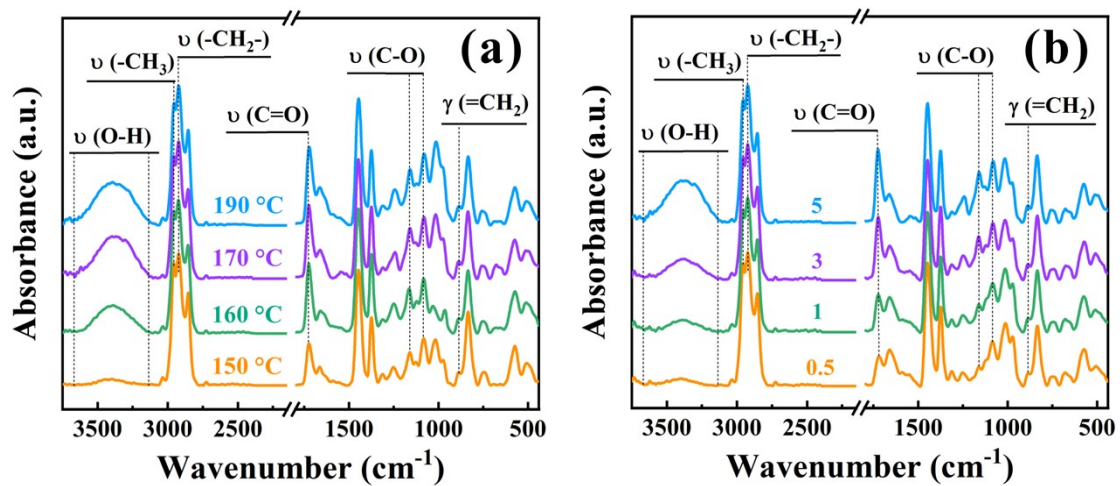


Figure S4. FTIR spectra of HM5-30-z (a) and HMx-30-170 (b) samples.

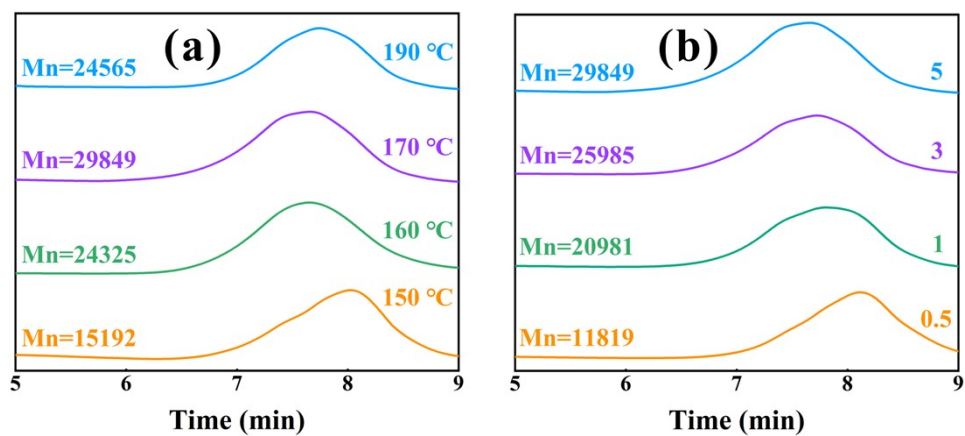


Figure S5. GPC profiles of HM5-30-z (a) and HMx-30-170 (b) samples.

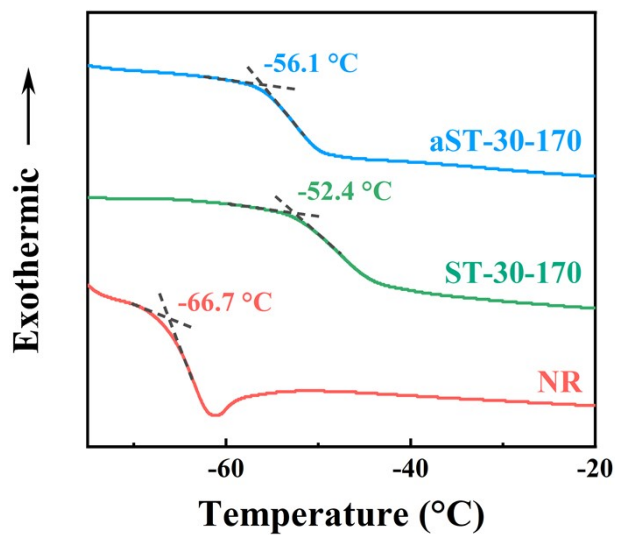


Figure S6. DSC profiles of NR gum, ST-30-170 and aST-30-170.

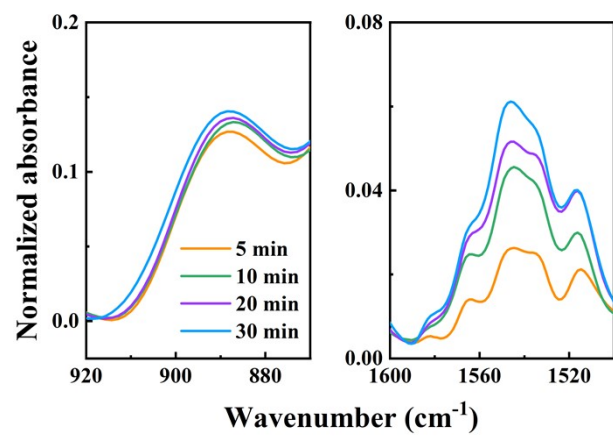


Figure S7. Detailed view of FTIR spectra of HM5-g-170 samples.

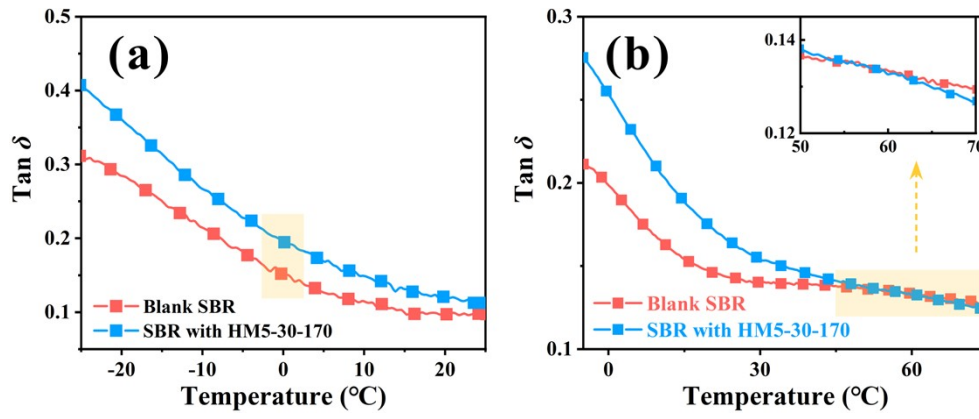


Figure S8. Temperature-dependent loss tangent ($\tan \delta$) curves of blank SBR and SBR with HM5-30-170 composites: skid resistance (a) and rolling resistance (b) experiments.

Table S1. Formulations of sulfur-crosslinked rubber granules.

Sample code	NR ^a (g)	SBR ^b (g)	ZnO ^c (g)	Sta ^d (g)	CZ ^e (g)	S ^f (g)
HS-NR	100	-	5	1	3	10
HS-SBR	-	100	5	1	3	10

aNR: Natural rubber; bSBR: Styrene butadiene rubber; ^cZnO: Zinc oxide; ^dSta: Stearic acid; ^eCZ: N-Cyclohexyl-2-benzothiazole sulfonamide; ^fS: Sulfur; Cross-linking temperatures of HS-NR and HS-SBR are 143 °C and 150 °C, respectively.

Table S2. Formulations of all rubber composites.

Sample code	SBR (g)	HM5-30-170 (g)	Silica (g)	ZnO ^a (g)	Sta ^b (g)	CZ ^c (g)	DM ^d (g)	S ^e (g)
Blank SBR	100	-	40	5	2	1.5	0.5	1.5
SBR with HM5-30-170	90	10	40	5	2	1.5	0.5	1.5

^aZnO: Zinc oxide; ^bSta: Stearic acid; ^cCZ: N-cyclohexyl-2-benzothiazole sulfonamide; ^dDM: 2,2'-dibenzothiazole disulfide. ^eS: Sulfur; Cross-linking temperatures: 150 °C.

Table S3. Elemental contents of HM5-y-170 systems.

Sample code	N (%)	C (%)	H (%)	S (%)	O (%)
NR	0.40	84.60	11.41	0	4.750
HM5-5-170	0.00	76.57	10.47	5.05	6.144
HM5-10-170	0.01	73.40	10.02	5.69	7.974
HM5-20-170	0.00	73.27	10.45	5.30	8.346
HM5-30-170	0.02	71.98	10.83	5.33	11.168

Table S4. Mechanical properties of rubber composites. The standard deviation for each sample was determined from 6 specimens.

Sample code	TS ^a (MPa)	EB ^b (%)	TM ^c (MPa)
SBR	23.3±1.7	983±32	2.9±0.1
SBR with HM5-30-170	27.4±1.6	791±25	5.2 ±0.1

^aTS: Tensile strength; ^bEB: Elongation at break; ^cTM: Tensile modulus.