

Supplementary Material for

**Synthesis of phosphorus-containing cardanol-derived phenalkamine:
a sustainable curing agent to access high-performance bio-based
epoxy thermosets**

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Table S1. The curing kinetics parameters of the DGEBA/DDM, DGEBA/Car-DCP-DETA and DGEBA/Car-DPC-DETA curing systems.

Sample	T _{onset} (K)	T _p (K)	T _{end} (K)	E _a (kJ/mol)		n
				Kissinger	Ozawa	
DGEBA/DDM	326.3	394.6	478.6	43.35	47.91	0.91
DGEBA/Car-DCP-DETA	358.1	421.8	466.2	70.28	73.82	0.93
DGEBA/Car-DPC-DETA	374.6	432.8	472.1	129.26	129.93	0.95

Table S2. TGA data of the cured DGEBA/DDM, DGEBA/Car-DCP-DETA and DGEBA/Car-DPC-DETA thermosets in air and nitrogen atmospheres.

Sample	T _{.10%} (°C)		T _{.75%} (°C)		Char residue (%) at 800 °C		UL-94
	Air	N ₂	Air	N ₂	Air	N ₂	
	DGEBA/DDM	371.9	374.8	554.0	455.1	0.2	
DGEBA/Car-DCP-DETA	288.2	302.3	533.7	448.9	3.4	14.3	V-0
DGEBA/Car-DPC-DETA	310.3	327.8	531.2	421.0	0.9	6.5	NR

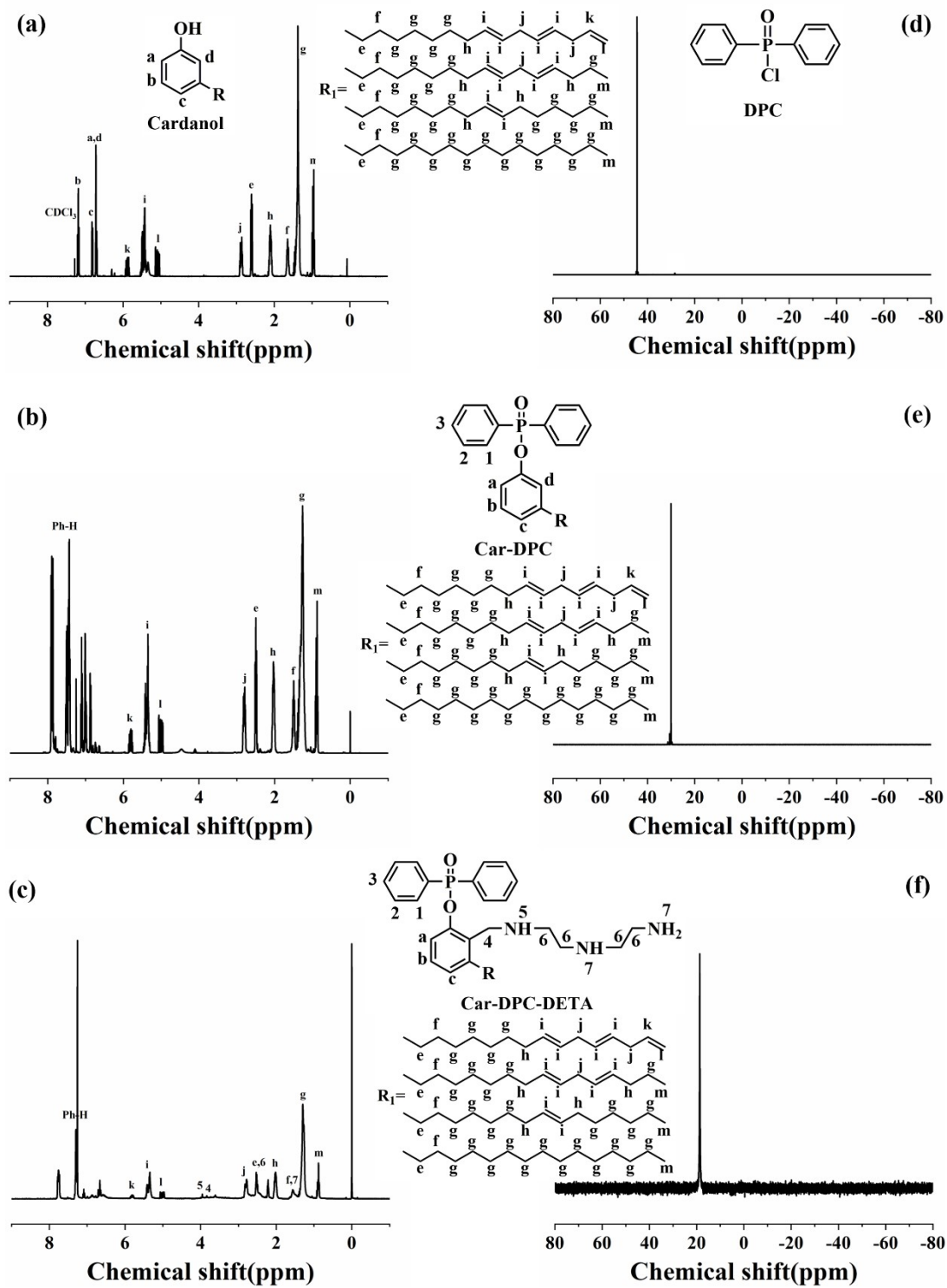


Fig. S1. The ¹H NMR spectra of (a) cardanol, (b) Car-DPC and (c) Car-DPC-DETA and the ³¹P NMR spectra of (d) DPC, (e) Car-DPC and (f) Car-DPC-DETA.

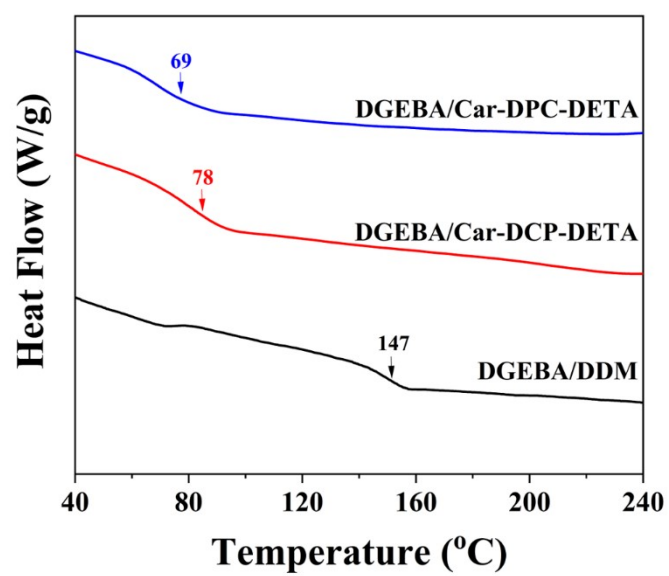


Fig. S2. DSC thermograms of the cured DGEBA/DDM, DGEBA/Car-DCP-DETA and DGEBA/Car-DPC-DETA.

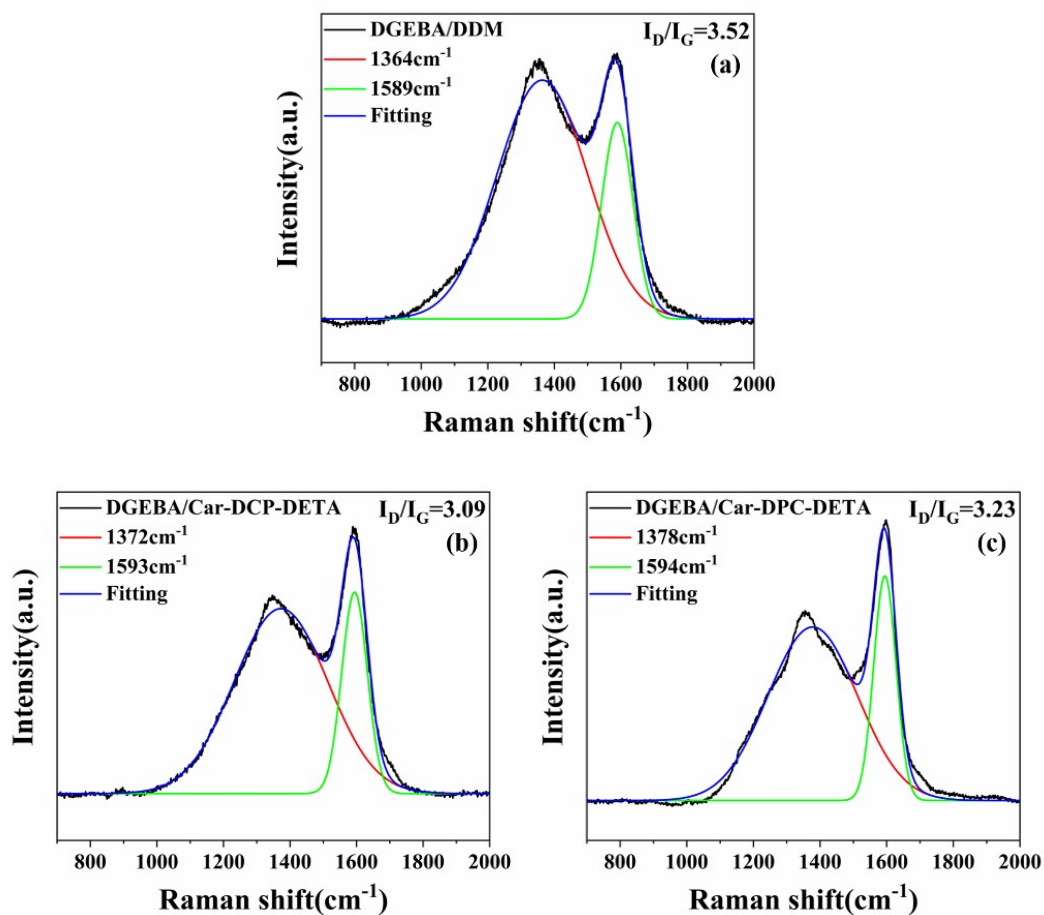


Fig. S3. Raman spectra of the char residues after the cone calorimeter test of (a) DGEBA/DDM, (b) DGEBA/Car-DCP-DETA and (c) DGEBA/Car-DPC-DETA.

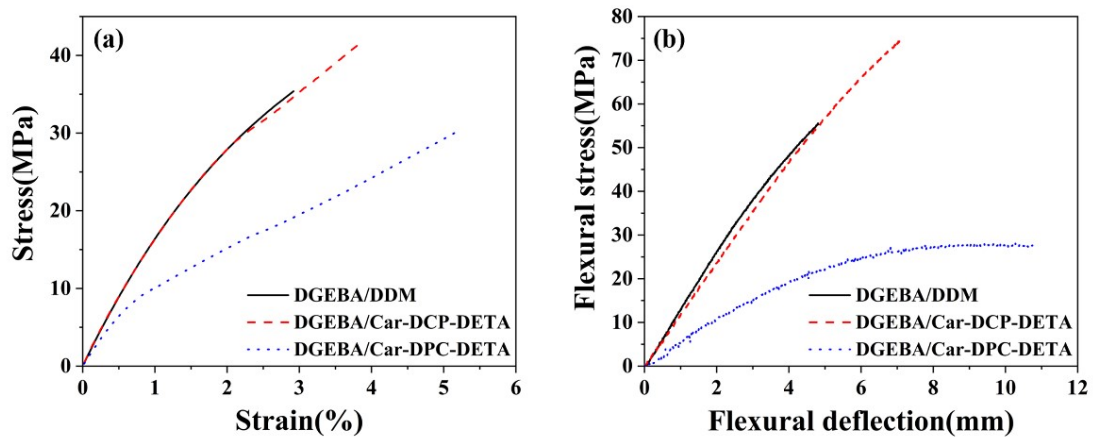


Fig. S4. (a) Tensile stress-strain curves and (b) flexural stress-strain curves of DGEBA/DDM, DGEBA/Car-DCP-DETA and DGEBA/Car-DPC-DETA.

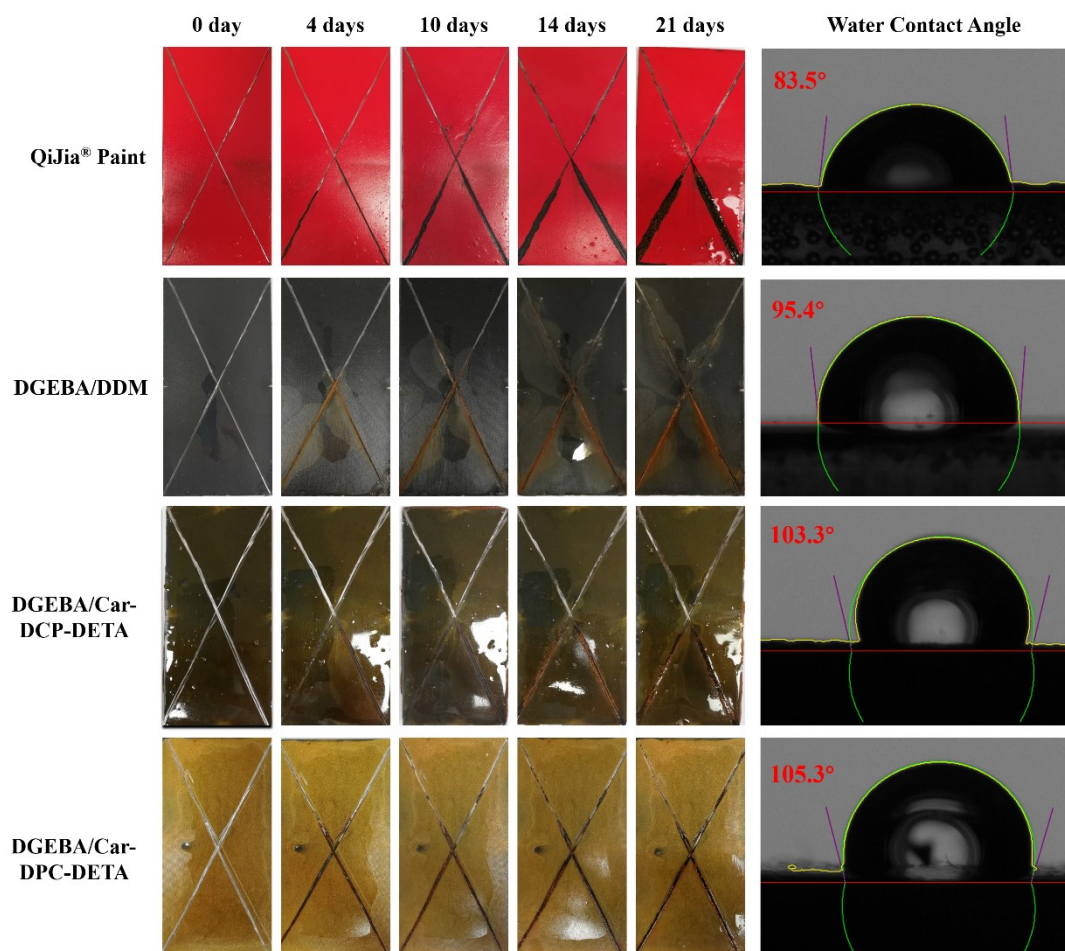


Fig. S5. Digital photographs of steel plates coated with DGEBA/DDM, DGEBA/Car-DPC-DETA, DGEBA/Car-DPC-DETA and a commercial epoxy-based coating (QiJia). The water contact angle (WCA) values of DGEBA/DDM, DGEBA/Car-DPC-DETA, DGEBA/Car-DPC-DETA and a commercial epoxy-based coating (QiJia).