Supporting Information

'Vitrimer nanocomposites' derived from graphene oxide and post-consumer recycled polypropylene

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Table S1: Formulation table of PCR PP and styrene assisted maleated PCR PP (m'-PCR PP)

Sample Name	PCR PP (wt %)	Maleic anhydride (wt %)	Styrene (wt %)	DCP (wt %)	Irganox (wt %)
PCR PP	100	-	-	-	-
m'-PCR PP	78.38	10	10.62	0.5	0.5

Table S2: Formulation table of PCR PP Vitrimer containing various concentration of TGDDM

Sample Name	m'-PCR PP (wt%)	TGDDM (wt%)	$Zn(OAc)_2$ (wt%)
5 TGDDM	94	5	1
10 TGDDM	89	10	1
15 TGDDM	84	15	1
20 TGDDM	79	20	1

Table S3: Formulation table of PCR PP vitrimer nanocomposites (with 15 TGDDM) containing two different concentrations of GO (0.5 and 1 wt% GO respectively)

Sample Name	m'-PCR PP (wt%)	TGDDM (wt%)	$Zn(OAc)_2$ (wt%)	GO (wt%)
0.5 GO	84	15	1	0.5
1 GO	84	15	1	1

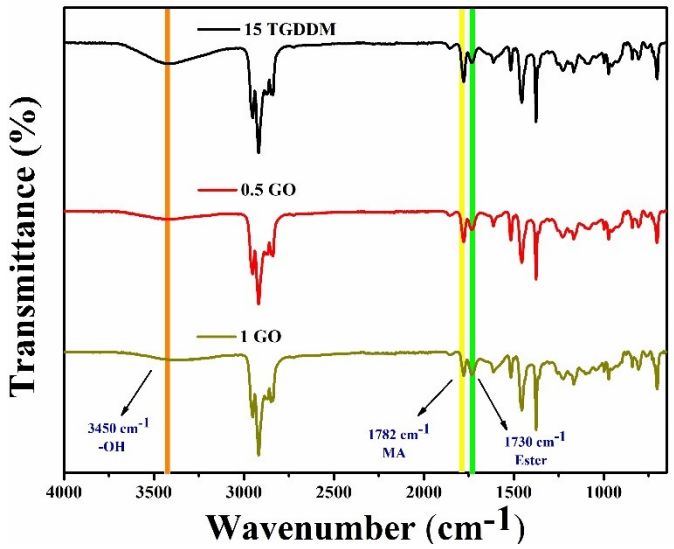

Figure S1: FTIR spectra for 15 TGDDM vitrimer and its nanocomposite containing 0.5 wt% and 1wt% GO.

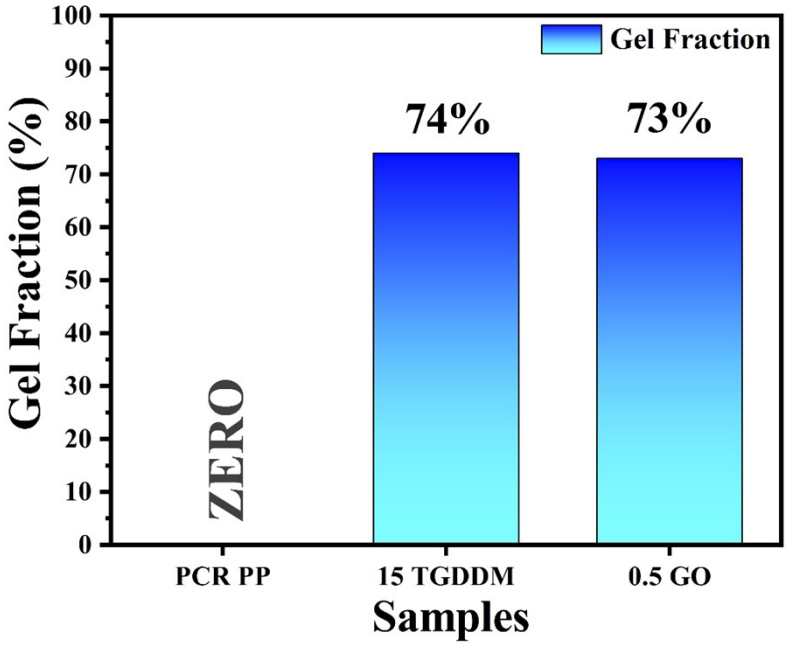

Figure S2: Gel fraction plot for PCR PP, 15 TGDDM vitrimer and its nanocomposite containing 0.5 wt% and 1wt% GO.

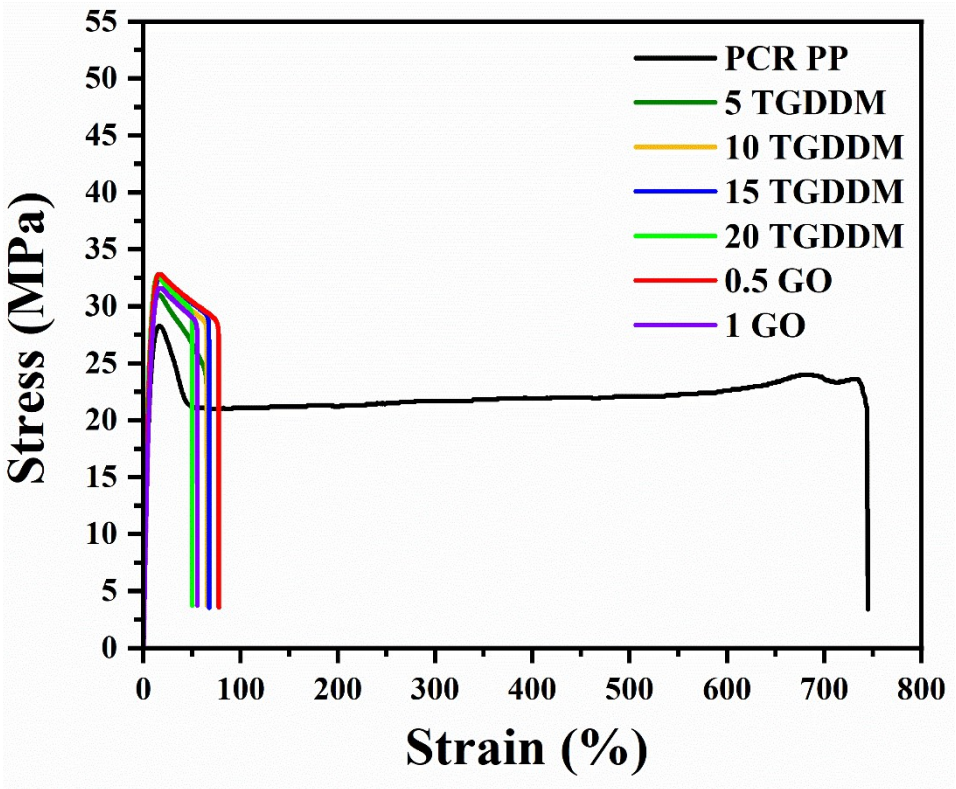

Figure S3: Stress-strain diagram of PCR PP, PCR PP vitrimers with various concentration of TGDDM and nanocomposites (with 15 TGDDM sample) at 0.5wt% and 1 wt% GO respectively.

Table S4: Mechanical properties of PCR PP, m'-PCR PP, PCR PP vitrimers with TGDDM, and its nanocomposite containing 0.5 and 1 wt% GO (with 15 TGDDM vitrimer sample)

Sample Name	Yield Strength (MPa)	Young's Modulus (MPa)	Elongation at yield (%)	Elongation at break (%)
PCR PP	28±0.35	171±4.04	16±0.37	745±272.20
m'-PCR PP	30±0.61	187±8.57	19±0.22	127±38.64
5 TGDDM	31±0.57	210±6.25	14±0.22	66±13.60
10 TGDDM	32±0.55	208±8.79	15±0.5	65±1.82
15 TGDDM	33±0.58	210±8.04	15±0.68	68±13.0
20 TGDDM	33±0.38	228±5.37	14±0.38	50±8.25
0.5 GO	33±0.72	216±6.58	15±0.68	78±27.29
1 GO	32±0.46	200±10.24	15±0.88	55±10.73

Table S5: Overview of melting temperature (T_m,), crystallization temperature (T_c), and percent crystallinity (%X*c)* obtained from DSC thermograms for PCR PP, PCR PP vitrimers with TGDDM, and its nanocomposite containing 0.5 and 1 wt% GO

Sample Name	T_m (°C)	T_c (°C)	% X_c
PCR PP	162	125	31
5 TGDDM	162	132	29
10 TGDDM	161	132	24
15 TGDDM	162	132	23
20 TGDDM	162	132	22
0.5 GO	162	132	23
1 GO	162	131	16

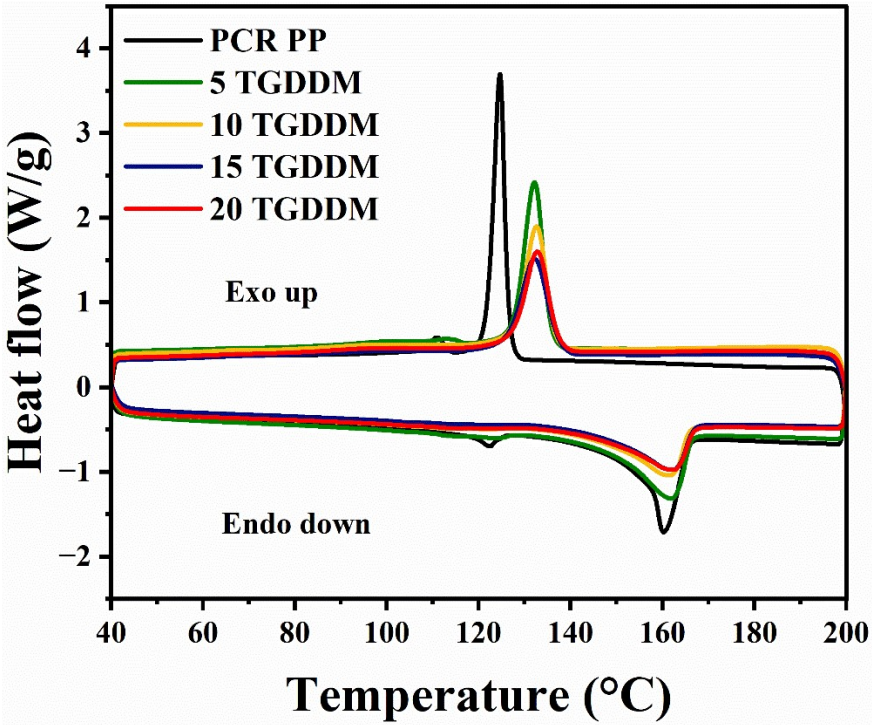

Figure S4: DSC thermogram illustrating melting and crystallization behaviour of PCR PP and vitrimers containing different concentrations of TGDDM crosslinker.

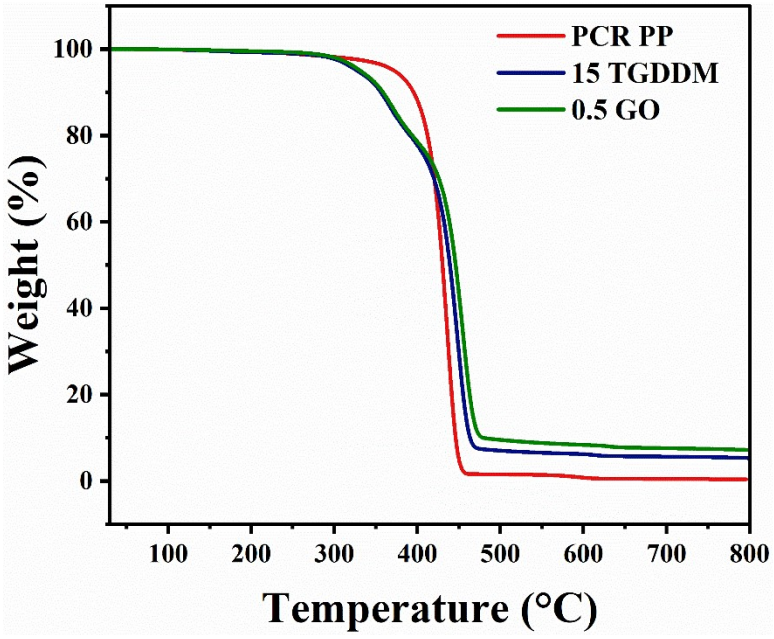

Figure S5: TGA thermogram as a function of temperature for PCR PP, 15 TGDDM vitrimer, and its nanocomposite with 0.5 wt% GO.

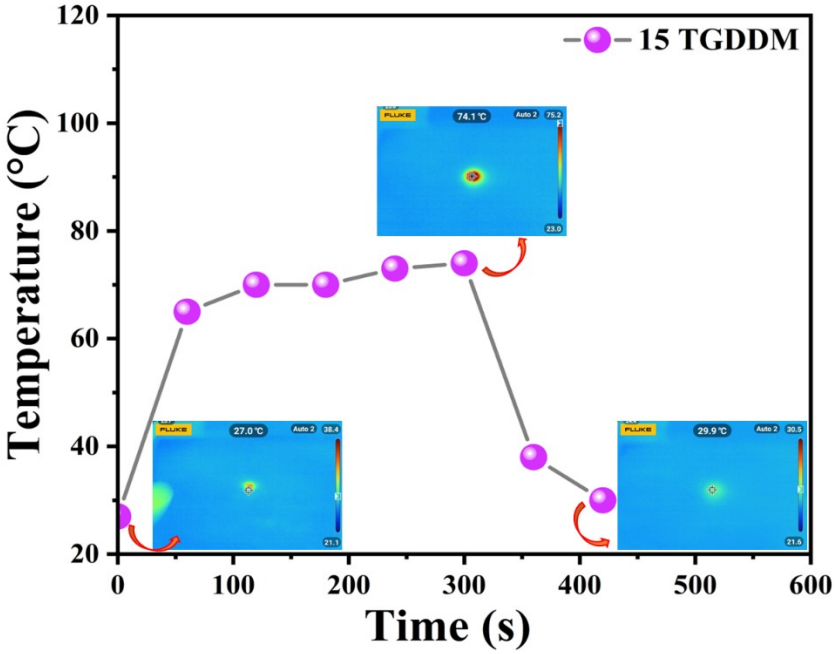

Figure S6: Photothermal study (temperature vs time plot) and corresponding infrared thermal image of PCR PP vitrimer containing 15 TGDDM epoxy subjected to laser heating for 5 min and cooling for another 5 min.

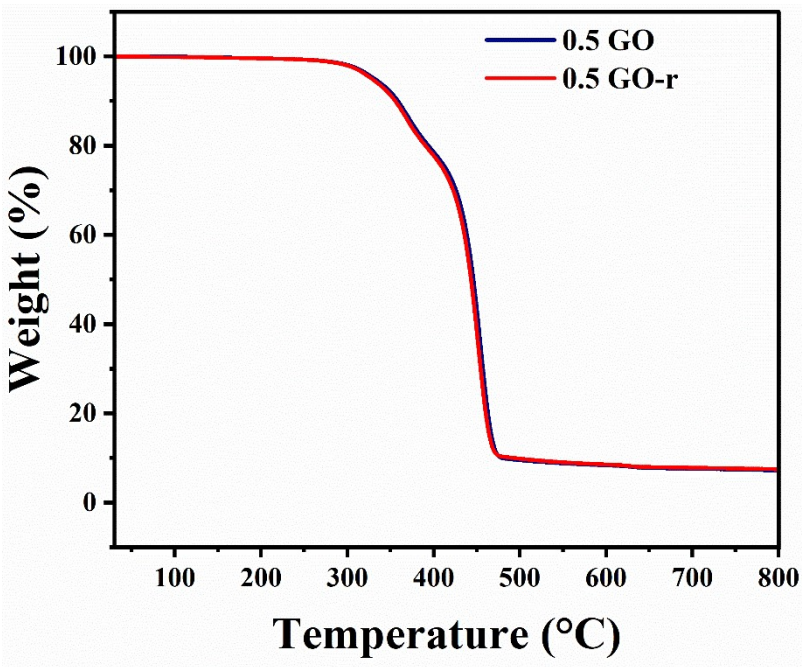

Figure S7: TGA analysis of PCR PP vitrimer nanocomposite (0.5 GO) before and after recycling.

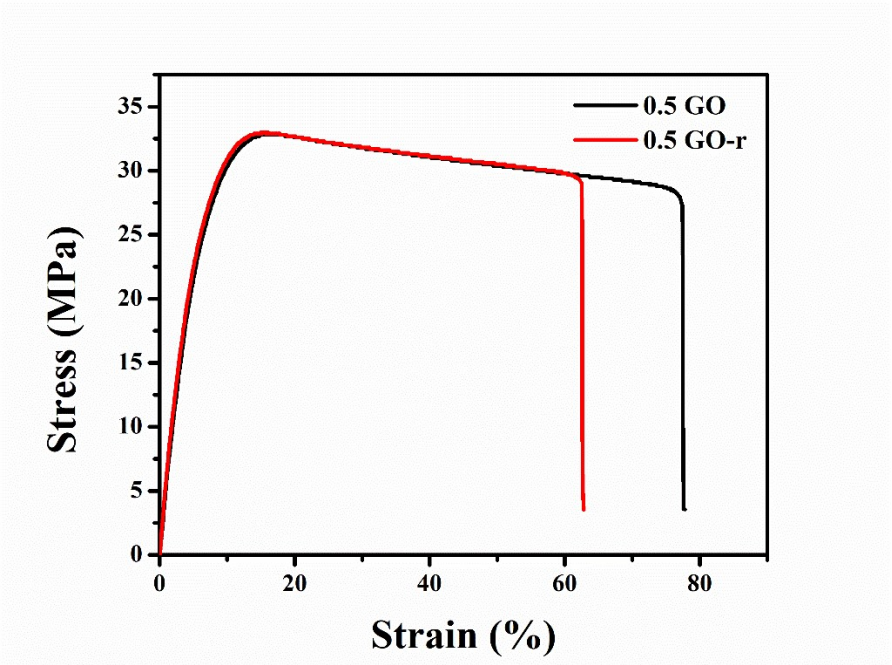

Figure S8: Stress-strain plot of PCR PP vitrimer nanocomposite (0.5 GO) before and after recycling.

Table S6: Mechanical characteristics of PCR PP vitrimer nanocomposite (0.5 GO) before and after recycling.

Sample Name	YS (MPa)	Recovery of YS (%)	YM (MPa)	Recovery of YM (%)	EY (%)	Recovery of EY (%)
0.5 GO	33±0.72	-	216±6.58	-	15±0.68	-
0.5 GO-r	33±0.50	100	211±6.39	90	15±0.40	98

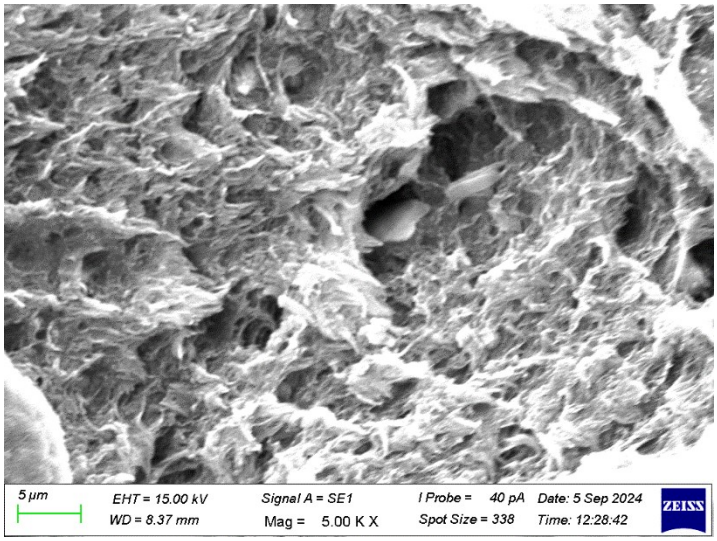

Figure S9: SEM micrograph of tensile fractured surface of PCR PP vitrimer nanocomposite (0.5 GO-r sample) post recycling.