# Supplementary Information

# Catalytic Amount of Sodium-Sulfonate-Naphthol Enables Mechanically Robust, Ultra-Transparent, Super-Fire-Resistant and Easy-Recyclable Polycarbonate

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#### Materials

Diphenyl carbonate (DPC) (99%) and bisphenol A (BPA) (>99%) were purchased from Aladdin Chemistry Co., Ltd. (Shanghai, China). Sodium 2,3-dihydroxynaphthalene-6sulfonate (SN monomer) was provided by Energy Chemical Co., Ltd. (Shanghai, China). Sodium hydroxide, dichloromethane, methyl sulfoxide (DMSO), ethanolamine and anhydrous ethanol were obtained from Chengdu Chemical Industries Co., Ltd. (Chengdu, China). All chemicals were used as received without further purification.

### Synthesis of PC-SN<sub>n</sub>

PC-SN<sub>n</sub> copolymers containing SN unit were synthesized via transesterification and melt polycondensation (**Scheme S1**), where n represents the molar percentage of SN units in copolymer chain. The synthesis procedure is shown as follows (taking PC-SN<sub>1</sub> as an example): 67.80 g (0.297 mol) BPA, 0.787 g (0.003 mol) SN and 67.50 g (0.315 mol, slightly excess relative to BPA) DPC were put into a 250 mL three-necked polymerization bottle, and suitable amount of NaOH solution (0.01 mol L<sup>-1</sup>) was added as a catalyst. Under nitrogen atmosphere, the mixture was mixed and heated at 160 °C for 1 h, and then slightly vacuumed to make the reaction melt bubble evenly. Then, the temperature was gradually raised to 280 °C, during which phenol was gradually extracted from the system. After the transesterification, the melt polycondensation reaction was conducted under high vacuum (<150 Pa) for 1 h to obtain the PC-SN<sub>1</sub> copolymer. Subsequently, the product was cooled to room temperature, dissolved in methylene chloride and then dried to remove broken glass. By controlling the additive amount of BPA and SN, pure PC, PC-SN<sub>0.1</sub>, PC-SN<sub>0.2</sub>, PC-SN<sub>0.3</sub>, PC-SN<sub>0.5</sub>, PC-SN<sub>2</sub> were synthesized according to the same steps.



Scheme S1. Synthesis of PC-SN<sub>n</sub> copolymer.

#### Calculation of the SN unit content

The weight contents of SN unit in  $PC-SN_n$  are calculated according to the following formula, where 254 and 288 are the molecular weights of the polycarbonate repeating unit and the SN repeating unit, respectively.

weight content of SN unit =  $\frac{288n}{254(100 - n) + 288n}$ 

#### Chemical recycling of PC-SN<sub>n</sub> at end-of-life

The chemical depolymerization of PC-SN<sub>n</sub> was carried out in a round-bottom flask by reacting with ethanolamine at 50 °C. The detailed steps are shown as follows: 2.54 g (0.01 mol based on BPA unit) PC-SN<sub>0.5</sub>, 10 mL DMSO and 610  $\mu$ L (0.01 mol) ethanolamine were added into the 100 mL flask and then the clarified transparent depolymerization solution was obtained after reacting at 50 °C for 4 h. By vacuum distillation, DMSO can be recovered and the depolymerization concentrate was obtained. Then the concentrate was poured into excess deionized water and a large amount of BPA white precipitate was precipitated. So the recycled BPA can be recovered after filtering, washing and drying. Subsequently, the filtrate was subjected to rotary evaporation, and crystals were precipitated after cooling to obtain the 2-oxazolidinone.

#### Characterization

Nuclear magnetic resonance (NMR) spectra of Sodium 2,3-dihydroxynaphthalene-6sulfonate and PC-SN<sub>n</sub> were obtained by Bruker AV III HD-400 MHz NMR spectrometer (Germany) with DMSO-d<sub>6</sub> and CDCl<sub>3</sub> as the solvent.

Fourier transform infrared (FT-IR) spectra were performed on a Nicolet 6700 FTIR spectrometer (America) by the attenuated total reflectance (ATR) model in the wavenumber range from 500 to 4000 cm<sup>-1</sup>.

X-ray photoelectron spectroscopy (XPS) tests were conducted on a K $\alpha$  instrument (Thermo Fisher) with a source gun type of Al K $\alpha$ .

The molecular weights of PC and  $PC-SN_n$  were measured by Gel Permeation Chromatography (waters 2695, waters) in chloroform at 1 mL min<sup>-1</sup> flow rate.

Differential scanning calorimetry (DSC) was conducted on the TA DSC2500 (America) at a heating/cooling rate of 5 °C min<sup>-1</sup> under nitrogen atmosphere. The test procedure is as follows: the sample was first rapidly warmed up to 260 °C and held for 3 min to eliminate the thermal history, after that ramped down to 40 °C at 5 °C min<sup>-1</sup> and held for 3 minutes. In the next cycle, the temperature was ramped up to 260°C at 5 °C min<sup>-1</sup>, held for 3 min, and finally cooled down to 40 °C until equilibrium.

Thermogravimetric analysis (TGA) was performed on the NETZSCH TG 209 F1 (Germany) at a heating rate of 10 °C min<sup>-1</sup> from 40 °C to 700 °C under nitrogen and air conditions.

The sulfur (S) content of  $PC-SN_n$  was measured by Agilent 5100 SVDV (America) inductively coupled plasma optical emission spectrometer (ICP-OES).

Limit oxygen index (LOI) was tested on JF-6 oxygen index instrument (Jiangsu, China) according to the ASTM D2863 standard with the sample size of  $130 \times 6.5 \times 3.2$  mm<sup>3</sup>.

Underwriter laboratory 94 (UL-94) vertical burning tests were conducted on KB-RS horizontal and vertical combustion testing instrument (Guangdong, China) according to the ASTM D3801 standard with the sample size of  $130 \times 13 \times 3.2 \text{ mm}^3$ .

The cone calorimetry tests were carried out using the FTT cone calorimeter device according to the ISO 5660 standard with the sample size of  $100 \times 100 \times 3 \text{ mm}^3$ , and the irradiation power was 50 kW m<sup>-2</sup>.

The microstructures of PC, PC-SN<sub>n</sub> and their residual chars after cone tests were observed by Phonom word Prox scanning electron microscopy (SEM) at voltages of 10 kV.

Pyrolysis-gas chromatography/mass spectrometry (PY-GC-MS) was performed on the CDS5200 pyrolyzer and DANI GC-TOG-MS equipment. The samples were heated to 550 °C for 20 s at a heating rate of 1000 °C s<sup>-1</sup> under helium atmosphere. And the test results were analyzed by the NIST library.

The tensile tests of PC and PC-SN<sub>n</sub> were conducted on a universal electronic material testing machine (INSTRON 3366, America) according to GB/T 1040.1-2006 at the speed of 10 mm min<sup>-1</sup> with the sample size of  $25 \times 4 \times 2$  mm<sup>3</sup>.

The notched impact tests were performed on an impact strength tester (ZBC1400 2) according to GB/T 1843-2008 with the sample size of  $80 \times 10 \times 4 \text{ mm}^3$  and the notched depth was 2 mm.

The transparency of PC and PC-SN<sub>n</sub> were measured by a UV-visible spectrophotometer (Cary 50) with the wavenumber ranging from 200 to 800 nm. And the thickness of the samples was 0.3 mm.

The purity of the recycled BPA was measured by testing the UV-Vis absorption spectrum of BPA in ethanol solution through the Cary50 UV-visible spectrophotometer.

The purity of the recycled 2-oxazolidinone was characterized using a Thermo Scientific TSQ9000 gas chromatography-mass spectrometry (GC-MS) system equipped with a TG-5 SILMS capillary column ( $30 \text{ m} \times 0.32 \text{ mm}$ ,  $0.25 \mu \text{m}$ ). The temperature was initially held at 45 °C for 5 min, then ramped to 290 °C at 10 °C min<sup>-1</sup> and maintained for 5 min. Helium was used as the carrier gas at a constant flow rate of 1.0 mL min<sup>-1</sup>. The mass spectrometer operated in electron ionization (EI) mode at 70 eV. Qualitative identification of components was achieved by matching the acquired mass spectra against the NIST database, while relative purity was quantified via the area normalization method.

The haze of PC and PC-SN<sub>n</sub> were conducted on a SGW-810 transmittance/haze tester (GBPI, China). The samples were 0.3 mm thick films, and each sample was measured five times.

The rheological behaviors of PC and PC-SN<sub>n</sub> were conducted on a Discovery HR-30 Hybrid Rheometer (TA, America), with the variable-frequency rheology measuring at 250 °C and a fixed 1% strain as well as the variable-temperature rheology measuring at 220-280 °C with a heating rate of 5 °C min<sup>-1</sup>. The sample size was 25 mm in diameter and 1 mm in thickness, which was prepared by a flat vulcanizer at 250 °C.



Fig. S1. (a) <sup>1</sup>H NMR and (b) FTIR spectra of SN monomer.

Sample	PC	PC-SN <sub>0.1</sub>	PC-SN <sub>0.2</sub>	PC-SN <sub>0.3</sub>	PC-SN <sub>0.5</sub>	PC-SN <sub>1</sub>	PC-SN <sub>2</sub>
E factor	0.784	0.784	0.784	0.783	0.782	0.781	0.777

Table S1. Environmental (E) factor of PC and PC-SN<sub>n</sub>.



Fig. S2. <sup>1</sup>H NMR spectrum of PC polymer.



Fig. S3. (a) Full XPS survey scans and (b) S2p, (c) Na1s XPS spectra of PC and PC-SN<sub>n</sub>.



Fig. S4. SEM-EDS element mapping images of PC and PC-SN $_n$ .

~ 1	theoretical	weight content	actual molar		
Sample	molar content of SN unit	theoretical content	actual content by ICP-OES	unit by ICP-OES	
PC-SN <sub>0.1</sub>	0.1 mol%	126 ppm	108 ppm	0.09 mol%	
PC-SN <sub>0.2</sub>	0.2 mol%	252 ppm	257 ppm	0.20 mol%	
PC-SN <sub>0.3</sub>	0.3 mol%	378 ppm	294 ppm	0.23 mol%	
PC-SN <sub>0.5</sub>	0.5 mol%	630 ppm	547 ppm	0.43 mol%	
PC-SN <sub>1</sub>	1.0 mol%	1259 ppm	1160 ppm	0.92 mol%	
PC-SN <sub>2</sub>	2.0 mol%	2516 ppm	2420 ppm	1.92 mol%	

Table S2. Theoretical and actual content of SN in  $\text{PC-SN}_{\text{n}}.$ 

	$\frac{M_n \times 10^4}{(\text{ g mol}^{-1})}$	$M_w  imes 10^4 \ ( ext{ g mol}^{-1})$	$M_z  imes 10^4 \ ( ext{ g mol}^{-1})$	Polydispersity
РС	1.87	3.85	6.86	2.06
PC-SN <sub>0.1</sub>	1.97	3.55	5.49	1.81
PC-SN <sub>0.2</sub>	2.08	3.49	5.26	1.68
PC-SN <sub>0.3</sub>	2.39	4.17	6.46	1.75
PC-SN <sub>0.5</sub>	2.30	4.00	6.16	1.74
PC-SN <sub>1</sub>	1.86	3.12	4.67	1.68
PC-SN <sub>2</sub>	1.84	3.31	5.21	1.80
Repolymerized PC-SN <sub>0.5</sub>	2.12	3.93	6.22	1.85

Table S3. The molecular weights of PC and PC-SN $_n$  by GPC test.



Fig. S5. TG thermograms of PC and PC-SN $_{n}$  in air atmosphere.

		$N_2$			Air		
Sample	$I_g(^{\circ}\mathrm{C})$	<i>T</i> <sub>5%</sub> (°C)	$T_{max}$ (°C)	R <sub>700</sub> (wt%)	<i>T</i> 5%(°C)	$T_{maxl}$ (°C)	$T_{max2}$ (°C)
PC	144	440	515	19.5	400	468	593
PC-SN <sub>0.1</sub>	143	453	500	21.3	423	454	565
PC-SN <sub>0.2</sub>	142	451	499	20.5	424	460	570
PC-SN <sub>0.3</sub>	142	462	497	20.0	420	463	564
PC-SN <sub>0.5</sub>	143	459	491	20.8	423	454	565
PC-SN <sub>1</sub>	141	453	490	19.8	414	461	570
PC-SN <sub>2</sub>	142	452	489	19.3	408	462	570

Table S4. Relevant data of PC and PC-SN<sub>n</sub> in DSC and TG test.



Fig. S6. Melt complex viscosity of PC and PC-SN<sub>n</sub> at (a) different frequency and (b) different temperature.

With the increase of shear frequency or temperature, both PC and PC-SN<sub>n</sub> exhibit shearthinning behavior, which is a typical feature of pseudoplastic fluids. The introduction of SN monomer leads to a decrease in the complex viscosity of PC-SN<sub>n</sub> copolymers, reflecting the enhanced melt fluidity and good processing properties. Combined with the experimental phenomena in the injection molding process, the optimal processing temperature range of PC and PC-SN<sub>n</sub> is between 240-270 °C.

Table S5. Dataset of flame-retardant PC materials.

Methods	Flame retardant systems	Addition amount (wt %)	Transmittance at 800 nm (%)	Δ <i>T</i> <sub>5%</sub> in N <sub>2</sub> (°C)	LOI (%)	Tensile strength (MPa)	Notched impact strength (kJ/m <sup>2</sup> )	Ref.
	CeP <sub>n</sub>	4	90.1	+10	27.3	58.1	Not given	1
	PBS	2	opacity	-2	31.2	~55	Not given	2
	OPS	6	Not given	-33	33.8	59.3	15.0	3
	sSEBS-Ce	1.5	91.1	-14	33.5	59.4	70.0	4
	ТСТР	4.0	76.4	-6	33.0	61.0	9.7	5
	DPOP-POSSs	6	78.0~80.0	-45	30.1	Not given	Not given	6
Physical	ASPC	20	87.7	-53	33.5	64.1	15.5	7
blending	NSD	6	Not given	-4	29.5	65.8	9.2	8
	PMD/PTFE	5.5	opacity	-37( <i>AT</i> <sub>1%</sub> )	36.3	58.0	Not given	9
	Zr-BDC	4	opacity	-32	28.2	58	Not given	10
	cyc-PPSQ	2	74.2	-13	37.5	57.3	Not given	11
	DVPOSSs	2	74.8	-17	28.5	Not given	Not given	12
	Ce(DPA) <sub>3</sub>	3	83.6	+32	26.9	56.7	60.0	13
	DP	2	89.1	-58	30.8	Not given	Not given	14
	PP-BPT	58.5 (50 mol%)	~85.0	-33	38.2	76.6	Not given	15
	PPN-PDMS	20.7 (20 mol% PPN+ 5 wt% PDMS)	opacity	-13.1	35.1	84.6	Not given	16
Chemical copolymer- ization		0.34 (0.3 mol%)	90.2	+22	36.0	86.1	67.2	
	SN	0.56 (0.5 mol%)	90.1	+19	36.5	85.3	69.1	This work
		1.13 (1 mol%)	89.8	+13	37.8	86.9	68.0	



Fig. S7. Haze values of PC and PC-SN $_n$ .

Sample	L*	a*	b*
PC	90.7±0.7	-0.37±0.06	0.39±0.13
PC-SN <sub>0.1</sub>	89.7±0.4	-0.01±0.12	0.56±0.19
PC-SN <sub>0.2</sub>	88.7±1.2	-0.24±0.37	0.68±0.18
PC-SN <sub>0.3</sub>	88.9±0.9	-0.02±0.13	0.96±0.20
PC-SN <sub>0.5</sub>	88.9±0.1	-0.08±0.11	2.77±0.09
PC-SN <sub>1</sub>	87.0±0.9	-0.23±0.20	2.34±0.43
PC-SN <sub>2</sub>	87.7±1.1	-0.01±0.20	1.98±0.33

Table S6. Relevant data of PC and PC-SN $_n$  in chromaticity test.

As shown in **Table S6**, PC-SN<sub>n</sub> maintains the good chromaticity of pure PC. The L value represents the brightness of the object, and 0-100 means from black to white, that is, the color is getting lighter and lighter. The a value represents the red-green color of the object, in which positive value means red and negative value means green. Similarly, the b value represents the yellow-blue color of an object, with positive values indicating yellow and negative values indicating blue. For PC-SN<sub>n</sub>, the L value is just slightly decreased and the b value (positive value) is slightly increased compared with PC, indicating that PC-SN<sub>n</sub> maintain good chromaticity.

Sample	Tensile strength (MPa)	Elongation at break (%)	Notched impact strength (kJ/m <sup>2</sup> )
РС	78.9±1.8	91.8±10.0	65.6±2.5
PC-SN <sub>0.1</sub>	84.0±2.3	96.2±17.8	66.3±2.2
PC-SN <sub>0.2</sub>	84.7±2.7	95.3±8.4	66.1±2.0
PC-SN <sub>0.3</sub>	86.1±3.3	94.5±8.1	67.2±2.6
PC-SN <sub>0.5</sub>	85.3±1.3	93.1±16.1	69.1±3.3
PC-SN <sub>1</sub>	86.9±1.1	92.9±5.8	68.0±1.7
PC-SN <sub>2</sub>	88.0±0.5	85.4±10.4	68.3±2.4

Table S7. Mechanical properties of PC and PC-SN<sub>n</sub>.



Fig. S8. The combustion process in UL-94 burning test for PC and PC-SN $_{0.5}$  with 1.6 mm thickness.

Sample	LOI	UL-94 (3.2 mm)			UL-94 (1.6 mm)		
	(%)	$t_1+t_2(s)$	Dripping	Rating	$t_1+t_2(s)$	Dripping	Rating
PC	25.5	25±3	Y	V-2	23±2	Y	V-2
PC-SN <sub>0.1</sub>	26.7	11±2	Ν	V-1	14±2	Ν	V-1
PC-SN <sub>0.2</sub>	32.5	6±2	Ν	V-0	13±2	Ν	V-1
PC-SN <sub>0.3</sub>	36.0	5±1	Ν	V-0	4±1	Ν	V-0
PC-SN <sub>0.5</sub>	36.5	3±1	Ν	V-0	4±1	Ν	V-0
PC-SN <sub>1</sub>	37.8	4±2	Ν	V-0	3±1	Ν	V-0
PC-SN <sub>2</sub>	38.8	3±1	Ν	V-0	2±1	Ν	V-0

Table S8. LOI and UL-94 combustion results of PC and PC-SN $_{\rm n}$ .



Fig. S9. (a) Heat release rate (HRR), (b)total heat release (THR), (c)smoke production rate (SPR) and (d) total smoke production (TSP) of PC and PC-SN<sub>n</sub> in cone calorimetry test.

Sample	pHRR (kW/m <sup>2</sup> )	THR (MJ/m <sup>2</sup> )	TSP $(m^2)$
PC	507	83.5	27.9
PC-SN <sub>0.5</sub>	423	85.1	23.5
PC-SN <sub>2</sub>	353	79.1	20.7

Table S9. Cone calorimetry data of PC and PC-SN<sub>n</sub>.



Fig. S10. CO, CO<sub>2</sub> production (per kg sample) and CO/CO<sub>2</sub> weight ratio of PC and PC-SN<sub>n</sub> in cone calorimetry test.



Fig. S11. Digital photographs and SEM images of char residues for PC, PC-SN $_{0.5}$  and PC-SN $_2$  after cone tests.



Fig. S12. (a) Full XPS survey scans and (b) S2p XPS spectra of the char residues after cone tests; (c) O1s and (d) S2p XPS spectra of the char residue for PC-SN<sub>2</sub>.

In **Fig. S12c**, peaks at 535.3 eV, 532.9 eV, 531.7eV and 530.9 eV in the O1s spectrum of PC-SN<sub>2</sub> are attributed to the bonding states of Na KLL Auger, -O, =O, and metal carbonates, respectively. While for the S2p spectrum (**Fig. S12d**), it can be deconvoluted into four peaks related to sulfate and sulfide. Due to the spin splitting of the 2p orbitals, the peak splitting fits for both sulfate and sulfide are a pair of peaks. With the larger peak area of sulfate, the elemental S mainly exists in the form of sulfate in the chars. Therefore, during the combustion, PC-SN<sub>n</sub> can decompose to produce sodium sulfonate, sodium sulfate and sulfuric acid.

Commis	Element content (mol%)					
Sample	С	Ο	Na	S		
Char of PC	87.38	12.62	-	-		
Char of $PC-SN_{0.5}$	85.69	13.55	0.76	-		
Char of PC-SN <sub>2</sub>	77.92	17.63	4.03	0.42		

Table S10. XPS data of the char residues for PC and PC-SN<sub>n</sub> after cone calorimeter test.

Table S11. XPS data of the original PC and PC-SN<sub>n</sub> polymer.

Somelo		Element con	tent (mol%)	
Sample	С	Ο	Na	S
РС	83.01	16.99	-	-
PC-SN <sub>0.5</sub>	84.88	15.02	0.05	0.05
PC-SN <sub>2</sub>	83.78	15.94	0.14	0.14



Fig. S13. Py-GC/MS test results of PC, PC-SN $_2$  and SN monomer.

peak	retention time	molecular weight	compound
1	9.00	94	он
2	10.68	108	——————————————————————————————————————
3	12.12	122	он
4	12.97	136	)—(С)—он
5	14.10	134	>-с>-он
6	18.80	214	Q.i.O
7	19.28	210	
8	20.66	212	C C OH
9	21.64	226	KO.O
10	23.36	214	носто
11	23.87	228	носто
а	12.85	132	€) →=o
b	17.15	144	ССС
c	18.56	186	
d	19.72	290	K
e	20.24	160	ОН
f	24.27	216	

Table S12. The detailed data of pyrolysis products in Py-GC/MS test.



Fig. S14. The depolymerization and separation process of  $PC-SN_n$  by reacting with ethanolamine in DMSO.



Fig. S15. Dissolution phenomenon of SN monomer in water.



**Fig. S16.** <sup>1</sup>H NMR spectra of (i) depolymerization solution of PC-SN<sub>0.5</sub> and (ii) an equal mixture of the theoretical depolymerization products.

In order to characterize the yield of bisphenol A and 2-oxazolidinone in the depolymerization solution, the quantification was performed by NMR internal standard method. Firstly, to eliminate the systematic error, an equal mixture of bisphenol A, 2-oxazolidinone and DMSO according to the composition of theoretical depolymerization products (2.28 g BPA, 0.87 g 2-oxazolidinone, 10 mL DMSO) was configured as a reference. Then, equal volumes of the mixture and the depolymerization solution were taken separately, with adding equal amount of mesitylene as the internal standard, the NMR characterizations were carried out with deuterated DMSO as the solvent, as shown in **Fig. S16**. The NMR peaks of the depolymerization solution behaved consistently with the theoretical mixture, proving a successfully depolymerization of PC-SN<sub>n</sub>. Besides, due to the equal amount addition of

mesitylene as the internal standard, the integral of its methyl peaks could be normalized to 1.00 to quantify the BPA and 2-oxazolidinone through the integral areas of their characteristic peaks. So the respective yields of BPA and 2-oxazolidinone could be calculated as following:  $Yield(bisphenol A)\% = \frac{4.57}{4.73} \times 100\% \approx 97\%$  $Yield(2 - oxazolidinone)\% = \frac{2.22}{2.29} \times 100\% \approx 97\%$ 



Fig. S17. <sup>13</sup>C NMR spectra of (a) recycled BPA and (b) recycled 2-Oxazolidone.



Fig. S18. XPS spectra of (a) standard BPA and (b) recycled BPA.



Fig. S19. HPLC analysis of recycled and standard BPA.



**Fig. S20.** UV-Vis absorption spectra of (a) standard BPA in ethanol and (b) standard BPA with different concentrations from 250 nm to 300 nm; (c) Standard curve of BPA.

The purity of the recovered BPA was measured and calculated using UV-Vis absorption spectroscopy. As shown in **Fig. S20a**, the characteristic absorption peak of bisphenol A in ethanol is located at 280 nm. Therefore, a standard curve can be developed by utilizing the different absorption intensity of different concentrations of BPA at 280 nm, from which the purity of the recovered BPA can be calculated by testing its absorption intensity in ethanol at 280 nm. A series of concentration (10 mg L<sup>-1</sup>, 20 mg L<sup>-1</sup>, 30 mg L<sup>-1</sup>, 40 mg L<sup>-1</sup> and 50 mg L<sup>-1</sup>) solutions were prepared using purchased standard BPA to perform UV-Vis absorption tests,

and the absorption peaks showed regular enhancement with increasing BPA concentration (shown in **Fig. S20b**). So, the standard curve was plotted as shown in **Fig. S20c** with a  $R^2$  of 0.9998, showing a strong linear pattern. Then, to calculate the purity of the recovered BPA, it was prepared into a solution of 30 mg L<sup>-1</sup> with ethanol. By testing the absorbance at 280 nm and substituting it into the standard curve, the actual concentration of the recovered BPA was calculated to be 29.88 mg L<sup>-1</sup>. Therefore, the purity of the recovered BPA was 99.6%.



Fig. S21. GC-MS result of the recycled 2-oxazolidinone.

The purity of the recycled 2-oxazolidinone was determined by gas chromatography-mass spectrometry (GC-MS, **Fig. S21**). The peak of 2-oxazolidinone appears at 13.6 min with a peak area of 58,342,435, while the peak of DMSO appears at 10.5 min with a peak area of 185,484. By calculating the relative peak area of 2-oxazolidinone, the purity of the recycled 2-oxazolidinone is determined to be 99.7%.



Fig. S22. (a) <sup>1</sup>H and (b) <sup>13</sup>C NMR spectra of original PC-SN<sub>0.5</sub> and repolymerized PC-SN<sub>0.5</sub>.



**Fig. S23.** (a) DSC curves and (b) TG thermograms in nitrogen of PC, PC-SN<sub>0.5</sub> and repolymerized PC-SN<sub>0.5</sub>.

Table S13. Mechanica	l properties of PC,	, PC-SN $_{0.5}$ and	repolymerized	$PC-SN_{0.5}$ .
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Sample	Tensile strength (MPa)	Elongation at break (%)
PC	78.9±1.8	91.8±10.0
PC-SN <sub>0.5</sub>	85.3±1.3	93.1±16.1
Repolymerized PC-SN <sub>0.5</sub>	84.4±5.5	89.5±7.7

In order to realize the closed-loop recycling of copolymerized PC, the recovered bisphenol A was repolymerized with DPC and SN to get PC-SN<sub>0.5</sub>. **Fig. S22** shows the <sup>1</sup>H and <sup>13</sup>C NMR spectra of original PC-SN<sub>0.5</sub> and repolymerized PC-SN<sub>0.5</sub>, with almost identical peaks, demonstrating the successful repolymerization. At the same time, the polymerization reaction requires a high purity of monomer, which further proves the high purity of the recovered BPA. Then, the thermodynamic and tensile properties of commercial PC, original PC-SN<sub>0.5</sub> and repolymerized PC-SN<sub>0.5</sub> were tested and compared, as shown in **Fig. S23** and **Table S13**. The repolymerized PC-SN<sub>0.5</sub> maintains high glass transition temperature and mechanical properties, while the thermal stability is improved compared with commercial PC.

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