Electronic Supplementary Material (ESI) for Polymer Chemistry
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Supporting Information

4-Dibenzocyclooctyol (DIBO) as an Initiator for Poly(ε-caprolactone): Copper-Free Clickable Polymer and Nanofiber-based Scaffolds

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Methods and materials

Chemicals and solvents were purchased from either Sigma-Aldrich or Acros and were used without further purification. All reactions were performed in anhydrous conditions under an atmosphere of Argon.Flash chromatography was performed on silica gel (Sorbent Technologies Inc., 70-230 mesh). Stannous octoate (Aldrich) and ε-caprolactone (Acros Organics) were distilled before use.

Size exclusion chromatographic analyses (SEC) were performed using a Waters 150-C Plus instrument equipped with three HR-Styragel columns [100 Å, mixed bed (50/500/103/104 Å), mixed bed (103, 104, 106 Å)], and three detectors including a differential refractometer (Waters 410), a differential viscometer (Viscotek 100), and a laser light scattering detector (Wyatt Technology, DAWN EOS, λ = 670 nm). THF was used as eluent with a flow rate of 1.0 mL/min at 30^0C. The Molecular weight and polydispersity were calculated according to light scattering data.

^{1}H Nuclear Magnetic Resonance (NMR) spectra was acquired using a Varian Mercury 300 NMR and 500 NMR spectrometer. UV-Vis spectra were measured using a SynergyTM MX plate reader from BioTek. SEM images were acquired using JEOLJSM-7401F with operating voltage as 1 kV. Fluorescence images were acquired using a CKX41 microscope (Olympus, Center Valley, PA).

4-dibenzocyclooctynol (DIBO) was synthesized according to our work described previously but is included for simplicity and convenience [1].

2,3:6,7-Dibenzo-9-oxabicyclo[3.3.l]nona-2,6-diene (1).

A 250 mL flask was flame dried and charged with argon. Phenylacetaldehyde (18.52 g, 0.154 mol) and 100 mL of chloroform (anhydrous) were then added via syringe. The reaction flask was cooled in an ice bath. Trimethylsilyl iodide (25 mL, 37.5 g, 0.188 mol) was added to the solution and the reaction was allowed to stand at 5 °C for 7 days. The reaction was monitored by TLC. After 7 days, sodium thiosulfate (1.0 M, 160 mL) and chloroform (200 mL) were added, and the mixture was stirred until the iodine color was discharged. The organic phase was separated, dried (sodium sulfate), and concentrated in vacuum. Chromatography on silica gel eluting with chloroform yielded 6.1 g of the crystalline ether compound (35%).

^{1}H NMR (300 MHz, $CDC1_3$) δ= 7.09 (m, 8H), 5.30(d, 2H, J=5.9 Hz, C*H*), 3.55(dd, 2H, J= 6.3, 16.2 Hz, CH_2), 2.75(d, 2H, J=16.4 Hz, CH_2); ^{13}C NMR (300 MHz, $CDC1_3$) δ=137.98, 131.79, 129.28, 127.02, 126.16, 125.35, 69.75, 36.31. ESI MS m/z 245.1334 [M+Na^+]; calcd for

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$C_{16}H_{14}NaO^+$: 245.0942

3-Hydroxy-2',3',2'',3''-tetramethox1y,-2 :5,6-dibenzocyclocta- 1,5,7-triene (2).
2,3:6,7-Dibenzo-9-oxabicyclo[3.3.l]nona-2,6-diene 1 (2.00 g, 5.84 mmol) in anhydrous THF (60 mL) was placed into a three-necked round bottom flask and cooled in an ice bath under argon. n-butyl lithium (4.92 mL, 2.5 M, 12.4 mmol) was added slowly via syringe. The reaction mixture was stirred at room temperature under argon for 4 h. The reaction was quenched by careful addition of water and extracted with 2X50mL $CHCl_3$. The combined organic phases were washed with 30 mL of brine, dried over Na_2SO_4, concentrated under vacuum and purified by column chromatography on silica gel $CHC1_3$ to yield 1.83 g of 3-Hydroxy-2',3',2'',3''-tetramethox1y,-2 :5,6-dibenzocyclocta- 1,5,7-triene (90%).
^{1}H NMR (300 MHz, $CDCl_3$): δ=7.48 (m, 1 H), 7.10–7.30 (m, 7H), 6.86 (q, 2H, J=2.7, 12.0 Hz, C*H*), 5.31 (q, 1H, J=6.1, 10.0 Hz, C*H*OH), 3.45 (m, 2H, CH_2); ^{13}C NMR (300 MHz, $CDCl_3$): d=140.9, 136.9, 136.3, 134.6, 131.8, 131.7, 130.3, 129.9, 129.3, 128.8, 127.3, 127.2, 126.1, 125.9, 74.7, 42.7. ESI MS m/z 245.1277 [M+Na^+]; calcd for $C_{16}H_{14}NaO^+$: 245.0942.

11,12-Dibromo-5,6,11,12-tetrahydro-dibenzo[a,e]cycloocten-5-ol (3).
Bromine (0.51 mL, 10 mmol) was added dropwise to a stirred solution of 2 (2.22 g, 10 mmol) in $CHCl_3$ (50 mL). After stirring the mixture for 0.5 h, TLC analysis indicated completion of the reaction. The solvent was evaporated under reduced pressure and the residue was purified by flash chromatography over silica gel (2:1/1:2, v/v, hexanes/CH_2Cl_2) to yield 3 as a light-yellow oil (60%).
^{1}H NMR (500 MHz, $CDCl_3$): δ=7.70–7.68 (2 H, aromatics), 7.39–6.88 (6 H, aromatics), 5.88 (d, 1H, J=5.4 Hz, C*H*Br), 5.47 (dd, 1H, J=3.6, 15.9 Hz, C*H*OH), 5.30 (d, 1H, J=5.4 Hz, C*H*Br), 3.60 (dd, 1H, J=3.7, 16.1 Hz, CH_2), 2.87 (dd, 1H, J=3.7, 16.1 Hz, CH_2); ^{13}C NMR (500 MHz, $CDCl_3$): δ=142.2, 138.9, 138.2, 135.0, 134.3, 132.5, 132.3, 131.1, 128.8, 127.2, 124.7, 122.3, 80.3, 70.6, 60.1 36.0. ESI MS m/z 402.9749 [M+Na^+]; calcd for $C_{16}H_{14}Br_2NaO^+$:402.9309.

5,6-Dihydro-11,12-didehydro-dibenzo[a,e]cycloocten-5-ol (4).
Lithium diisopropylamide in tetrahydrofuran (2.0 M; 8.0 mL, 16 mmol) was added dropwise to a stirred solution of 3 (1.53 g, 4.0 mmol) in tetrahydrofuran (40mL) under an atmosphere of argon. The reaction mixture was stirred for 0.5 h, after which it was quenched by the dropwise addition of water (0.5 mL). The solvents were removed under reduced pressure, and the residue was purified by flash chromatography on silica gel (hexanes/CH_2Cl_2 2:1/0:1, v/v) to yield 4 as a white amorphous solid (0.52 g, 60%).

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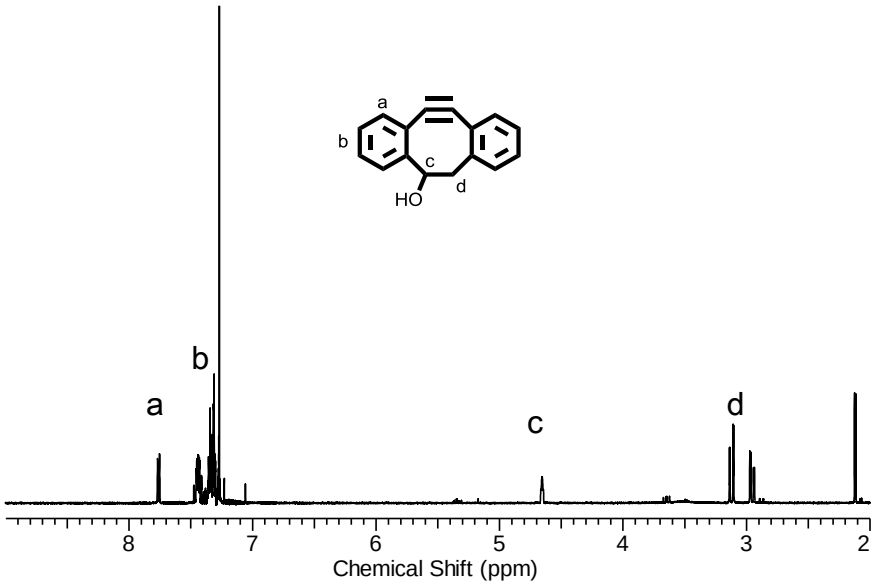

Figure S1. ^{1}H NMR spectra of DIBO

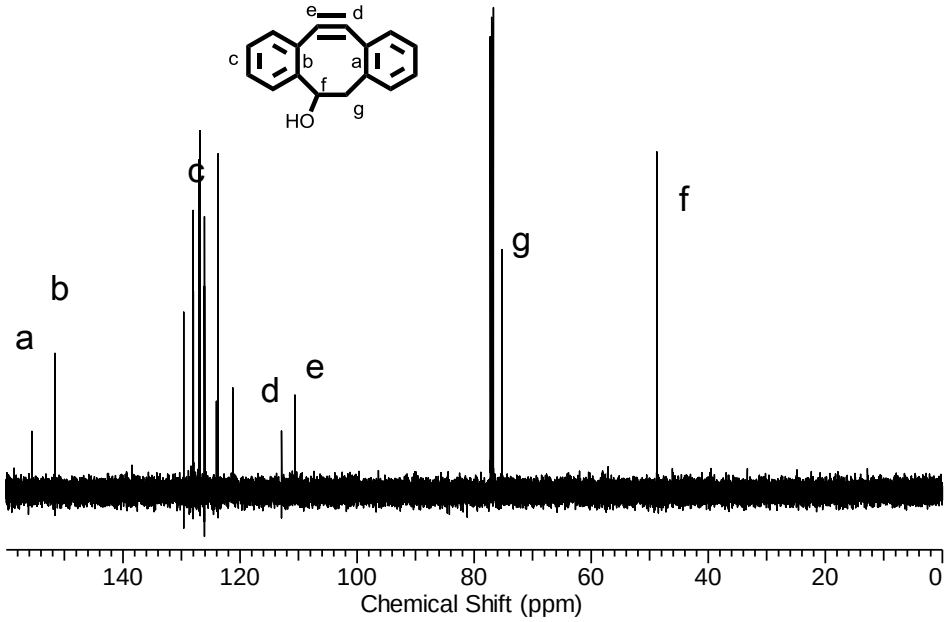

Figure S2. ^{13}C NMR spectra of DIBO

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DIBO-PCL (5): DIBO (28 mg, 0.13 mmol), ε-CL (2.50 g, 21.93 mmol) and freshly distilled stannous octoate (0.053 mmol) were added to a flame dried schlenk flask. After three cycles of freeze-pump-thaw degassing, the reactions were heated at 80 °C with varied reaction times. Following the designated polymerization time, the reaction was quenched in liquid nitrogen, dissolved in THF and precipitated in cold methanol. Molecular Mass, mass distribution, UV visible and NMR spectroscopy were collected as described above. The 1H NMR spectra for the end-functionalized PCL is shown below.

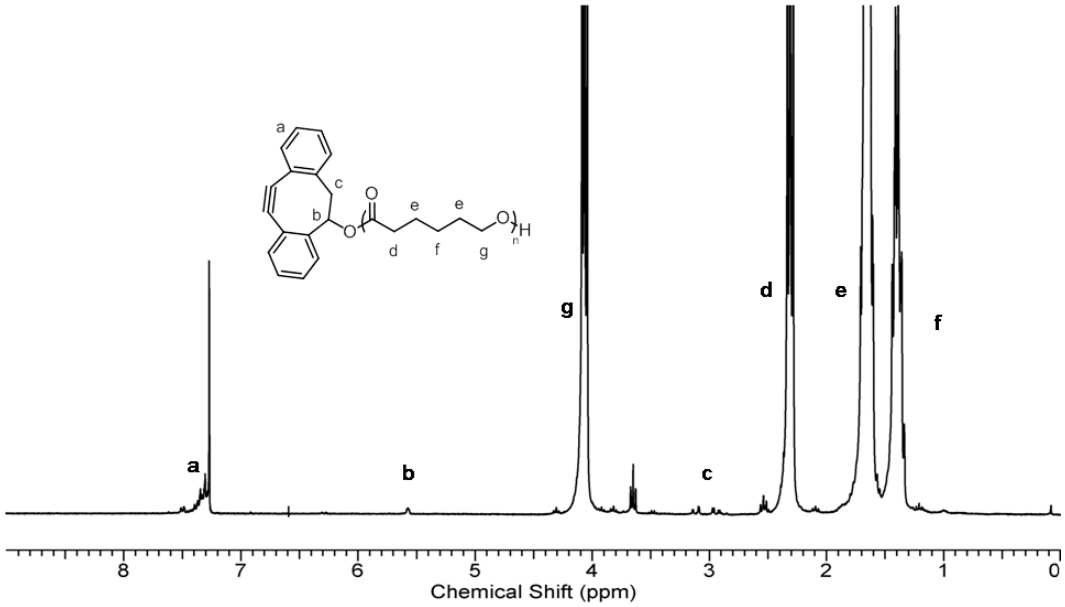

Figure S3. ^{1}H NMR spectra of DIBO-PCL

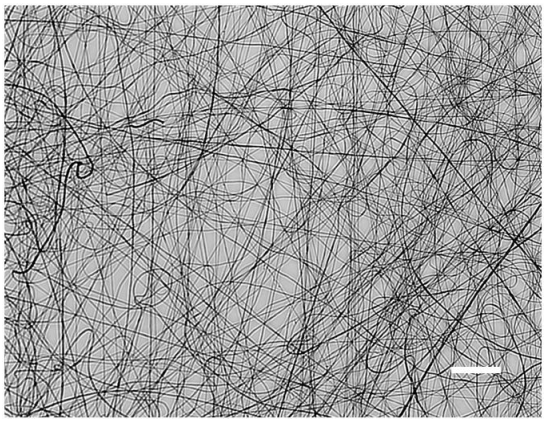

Figure S4. Optical image of the unmodified PCL fiber, the scale bar is 20 μm.

References

[1] aJ. G. Ngalle Eric Mbua, Margreet A. Wolfert, Richard Steet, Geert-Jan Boons, *chembiochem* **2011**, *12*, 1912 – 1921; bM. E. Jung, A. B. Mossman, M. A. Lyster, *The Journal of Organic Chemistry* **1978**, *43*, 3698-3701.