Supplementary Information

CO_2-derived functional polycarbonates as a sustainable platform for photosensitive polymeric materials

Andreia C. S. Gonzalez, Rafael T. Aroso, Carla Cunha, J. Sérgio Seixas de Melo, M. Ermelinda S. Eusébio, Teresa M. R. Maria, Gabriela J. da Silva, Pedro F. Cruz, Rui M. M. Brito, Rui M. B. Carrilho and Mariette M. Pereira**

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1. Nuclear Magnetic Resonance Spectroscopy (NMR)

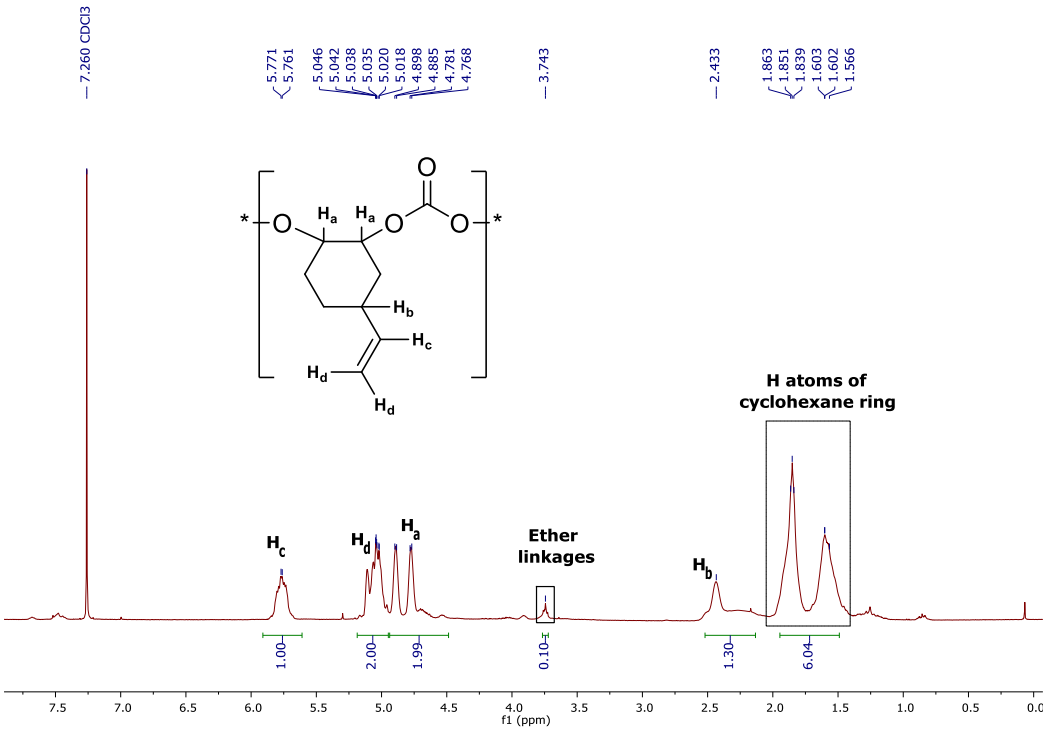


Figure S1 – ^{1}H NMR spectrum of **1-PS$_A$** in $CDCl_3$ at 25 °C.

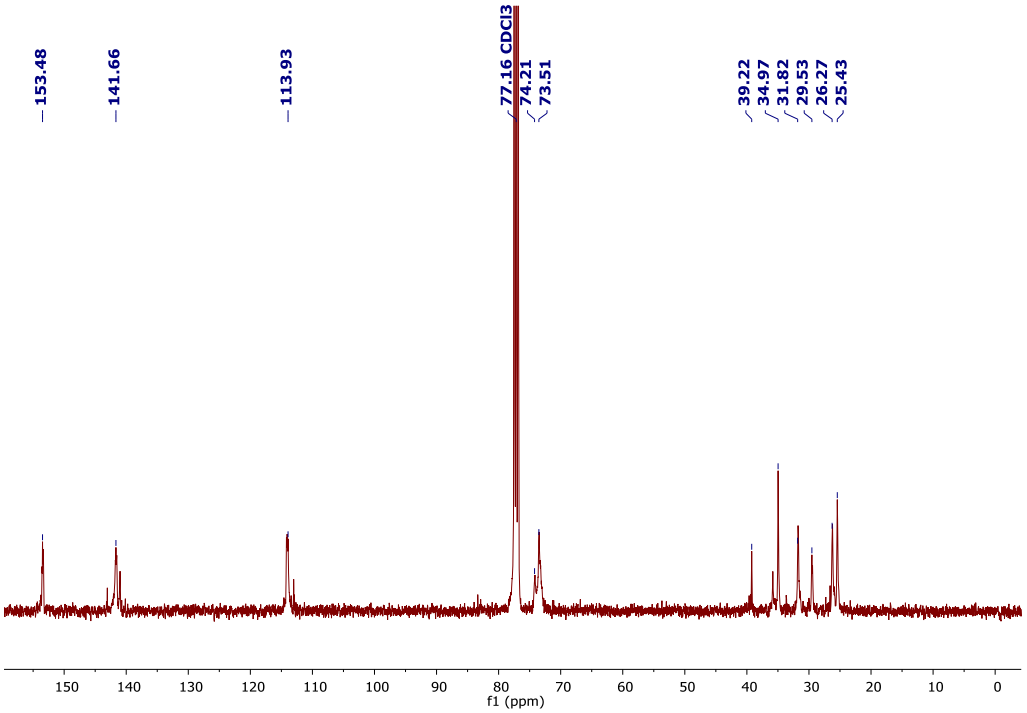


Figure S2 – ^{13}C NMR spectrum of **1-PS$_A$** in $CDCl_3$ at 25 °C.

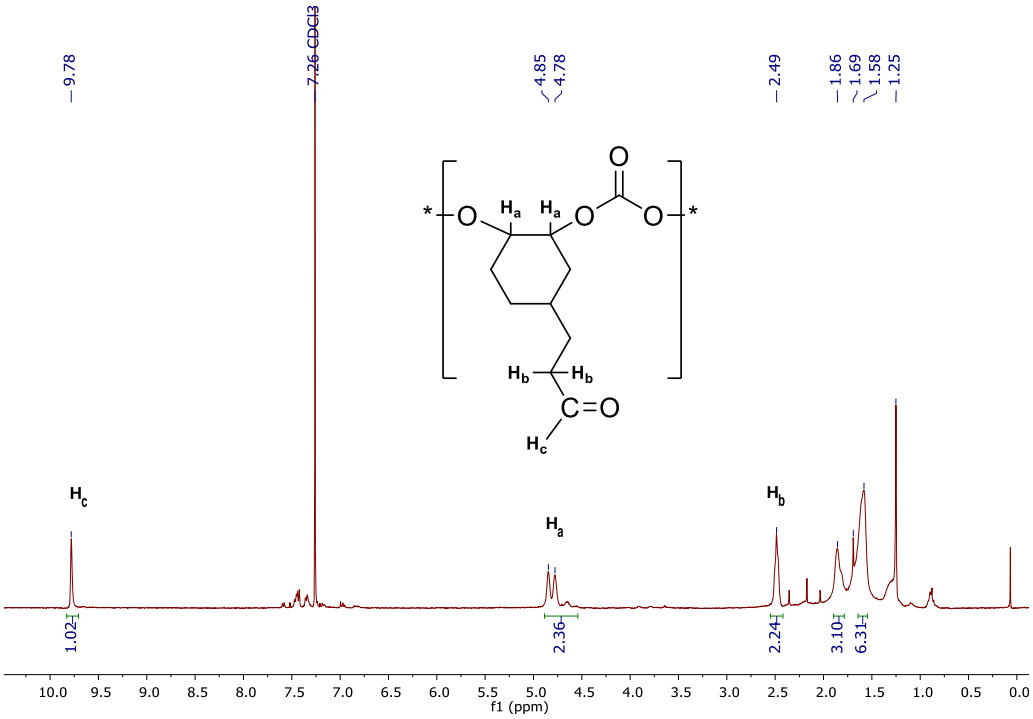


Figure S3 – ^{1}H NMR spectrum of **2-PS$_A$** in $CDCl_3$ at 25 °C.

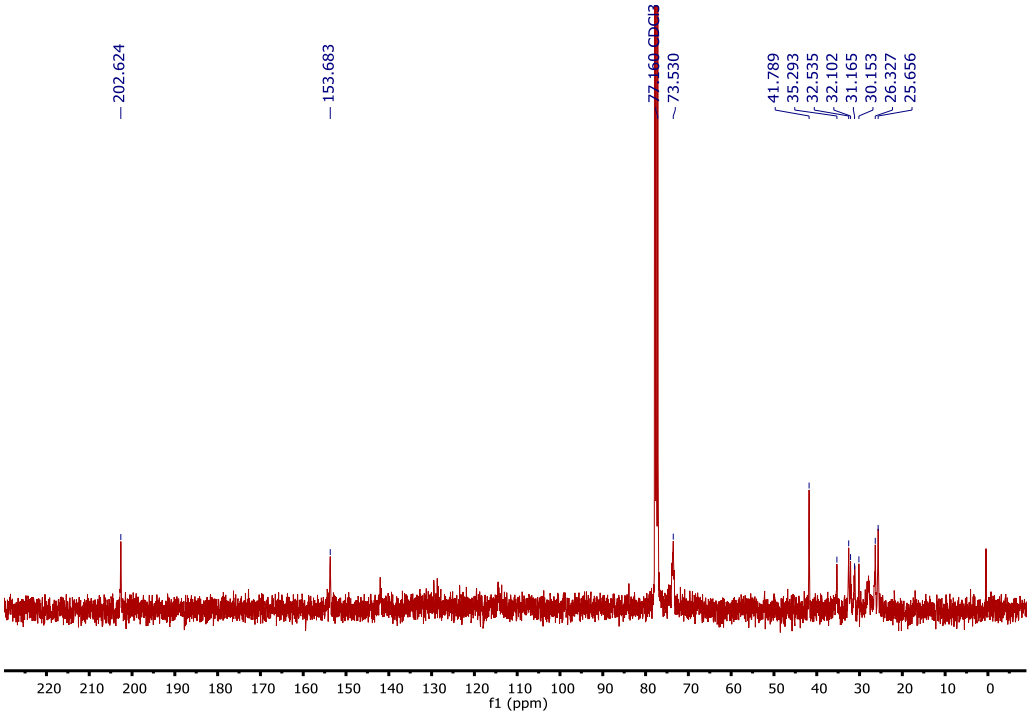


Figure S4 – ^{13}C NMR spectrum of **2-PS$_A$** in $CDCl_3$ at 25 °C.

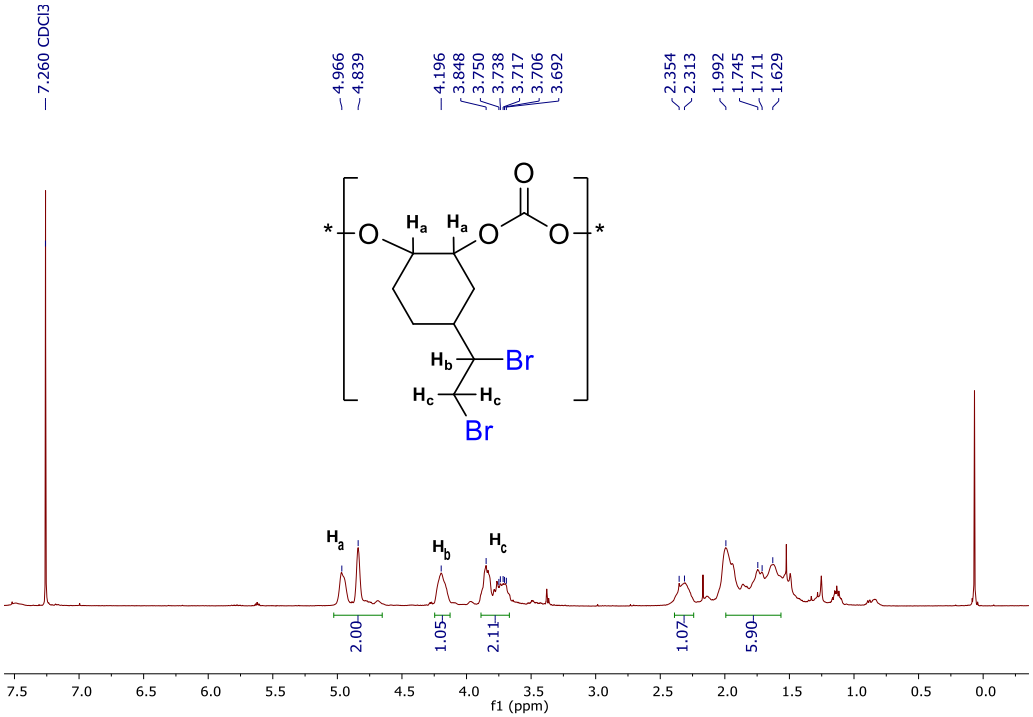


Figure S5 – ^{1}H NMR spectrum of **3-PS$_A$** in $CDCl_3$ at 25 °C.

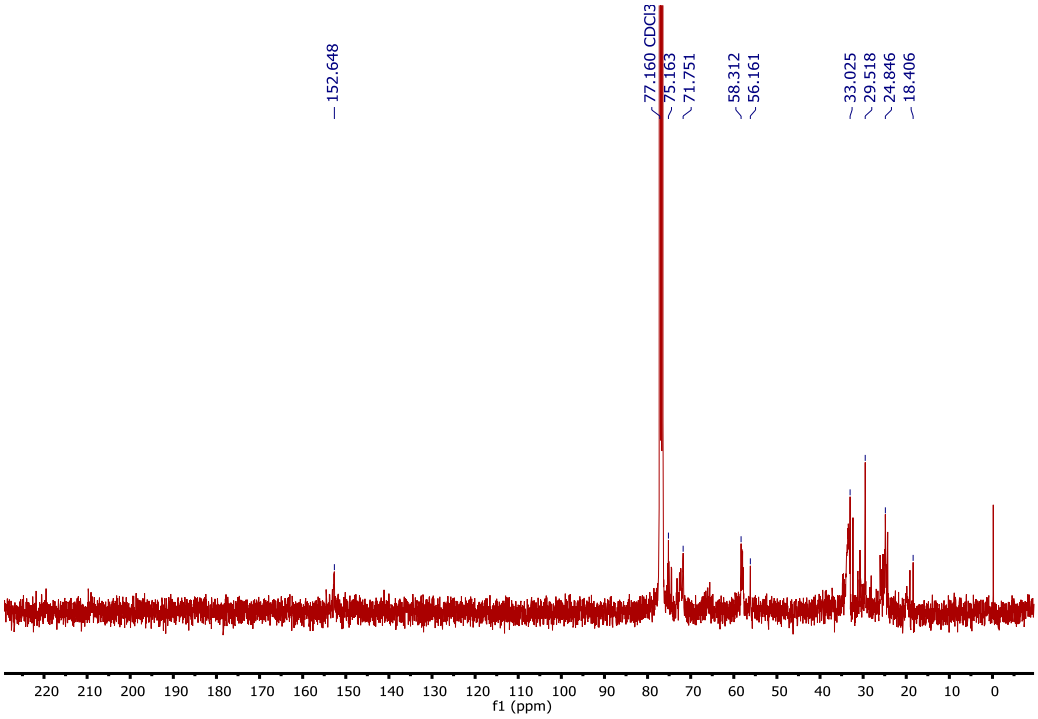


Figure S6 – ^{13}C NMR spectrum of **3-PS$_A$** in $CDCl_3$ at 25 °C.

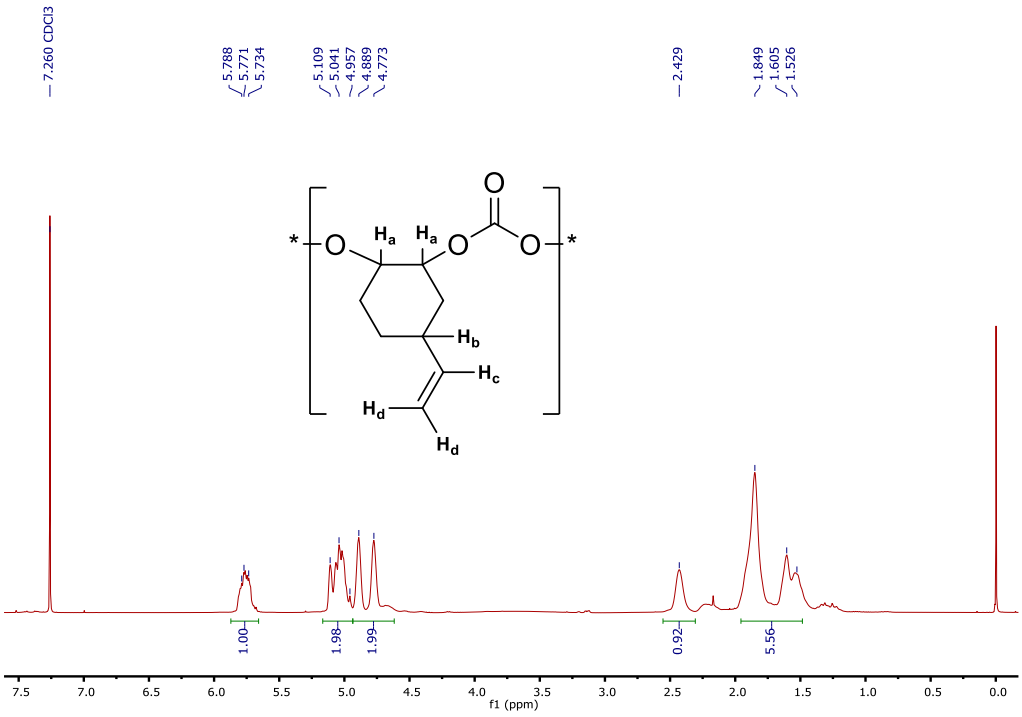


Figure S7 – ^{1}H NMR spectrum of **1-PS$_B$** in $CDCl_3$ at 25 °C.

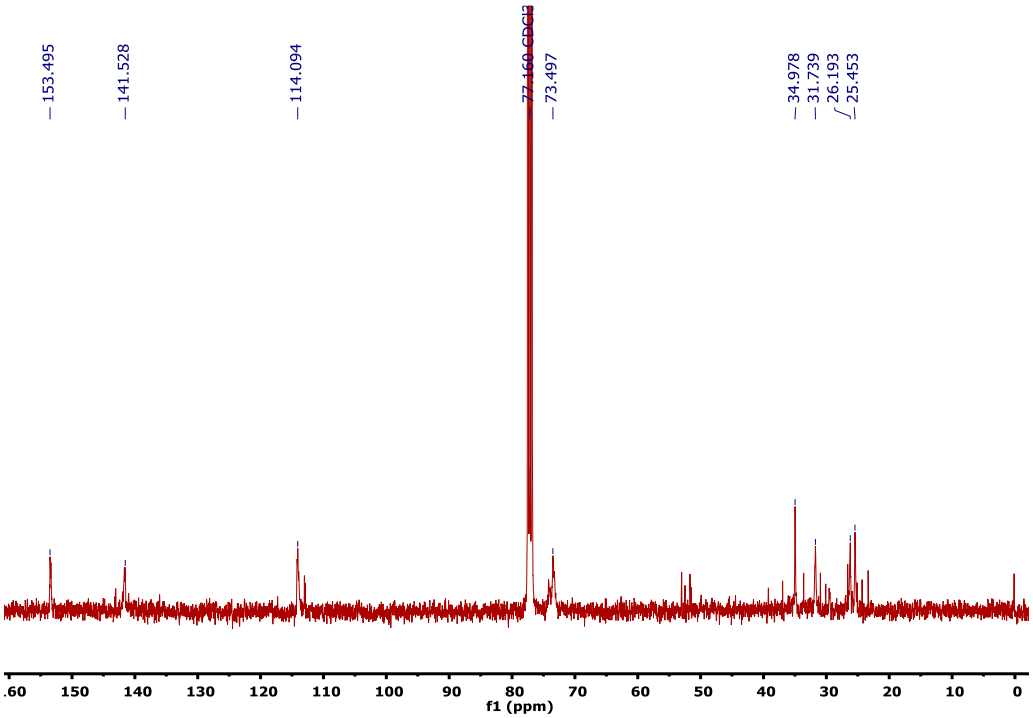


Figure S8 – ^{13}C NMR spectrum of **1-PS$_B$** in $CDCl_3$ at 25 °C.

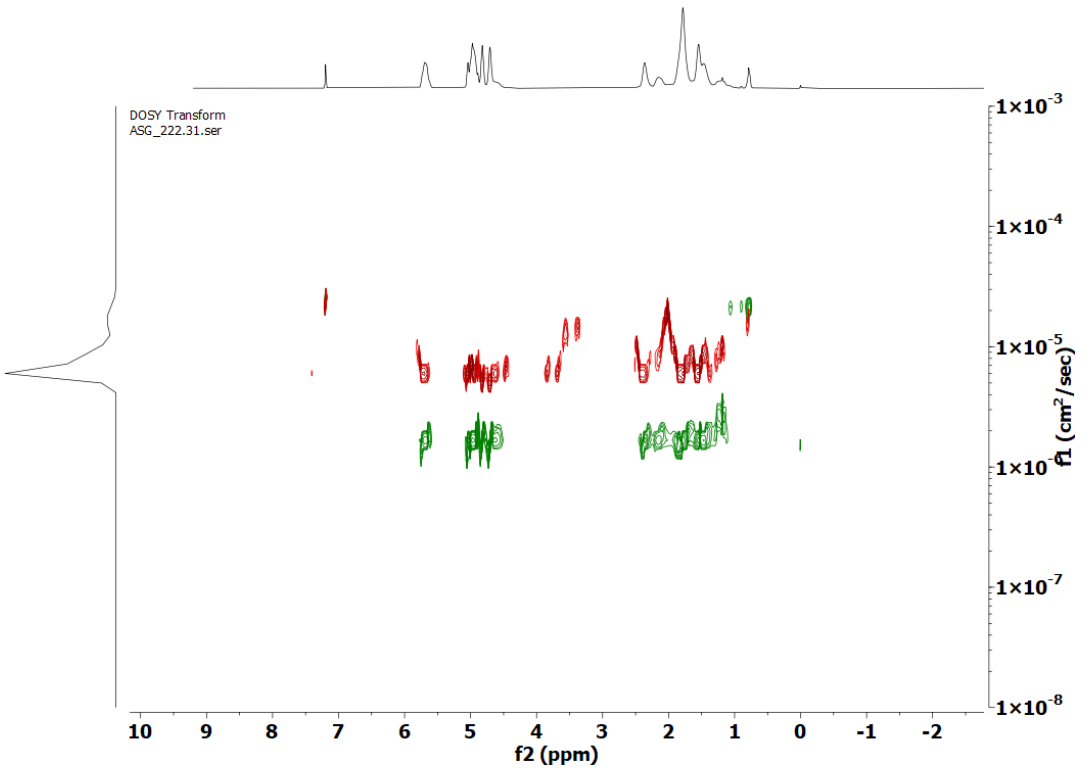


Figure S9 – ^{1}H NMR DOSY spectrum of **1-PS$_A$** (red) versus **1-PS$_B$** (green) in $CDCl_3$ at 25 °C.

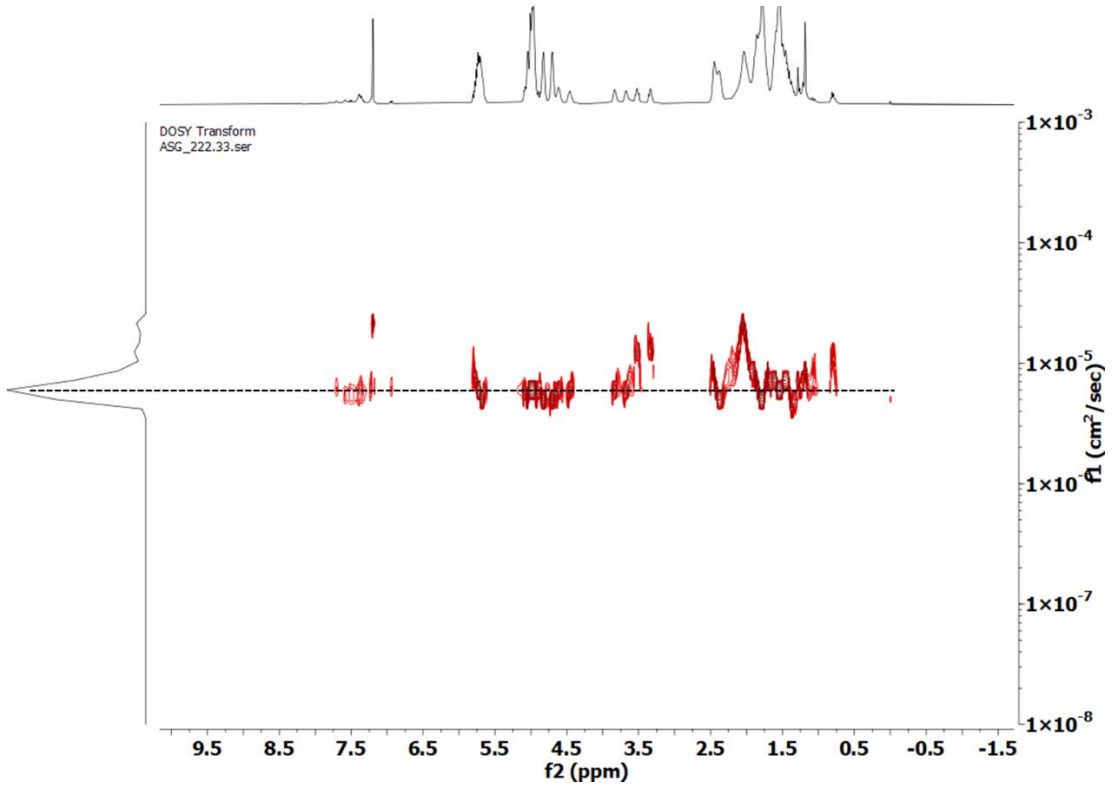


Figure S10 – ^{1}H NMR DOSY spectrum of **1-PS$_A$** + **PS$_A$** in $CDCl_3$ at 25 °C.

The signals assigned to the polycarbonate backbone (δ ≈ 0.5–6.0 ppm) and the aromatic protons assigned to PSA (δ ≈ 6.5–8.5 ppm) display the same diffusion coefficient (D ≈ 10^{-6}–10^{-5} cm² s^{-1}).

2. Size Exclusion Chromatography (SEC/GPC)

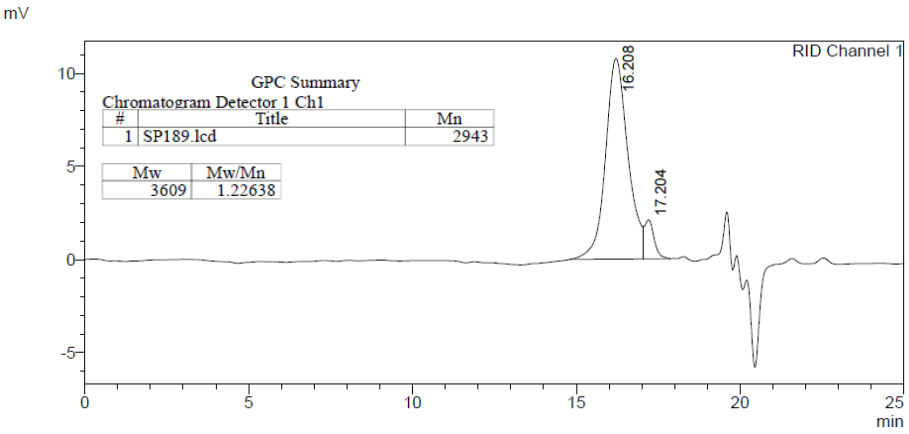


Figure S11 – SEC chromatogram of **1-PS$_A$** in THF, using a polystyrene standard.

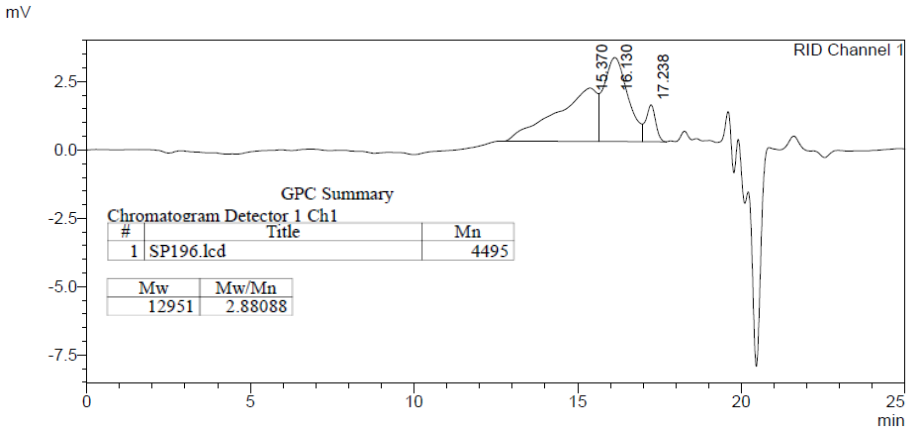


Figure S12 – SEC chromatogram of **2-PS$_A$** in THF, using a polystyrene standard.

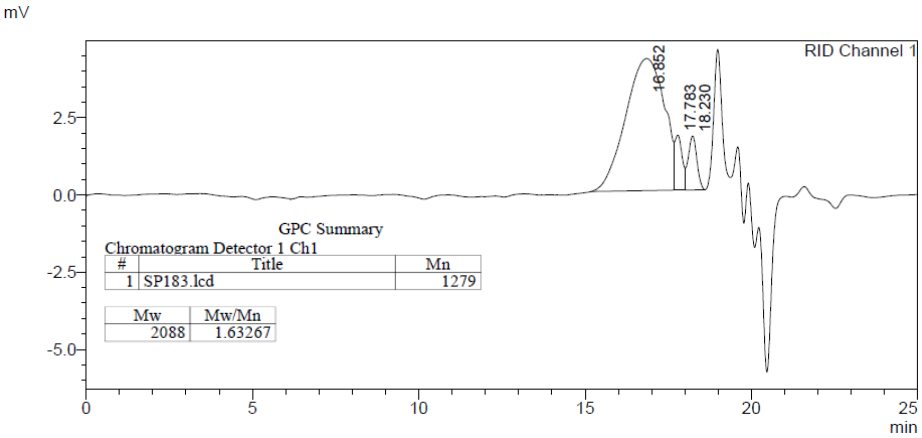


Figure S13 – SEC chromatogram of **3-PS$_A$** in THF, using a polystyrene standard.

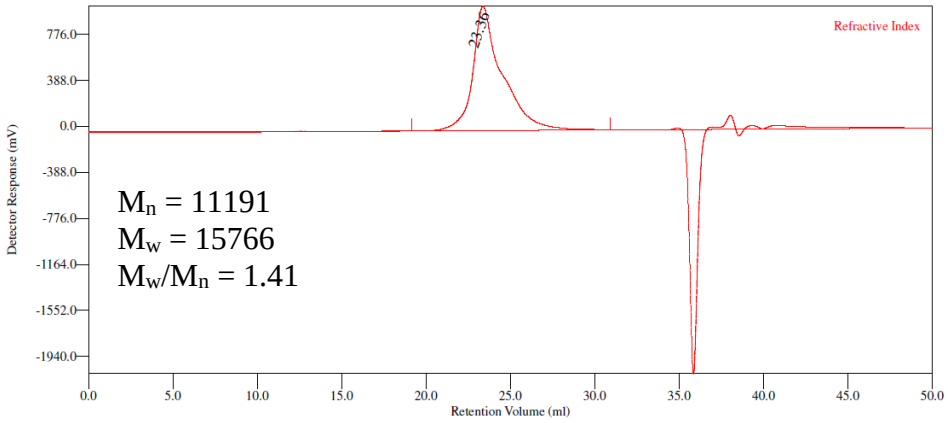


Figure S14 – SEC chromatogram of **1-PS$_B$** in THF, using a polystyrene standard.

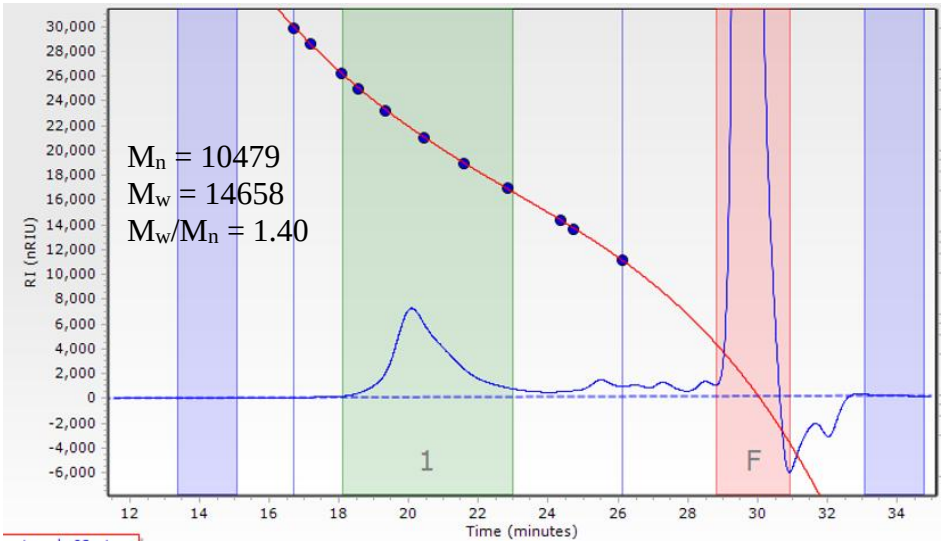


Figure S15 – SEC chromatogram of **3-PS$_B$** in THF, using a polystyrene standard.

3. Powder X-Ray Diffraction (XRD)

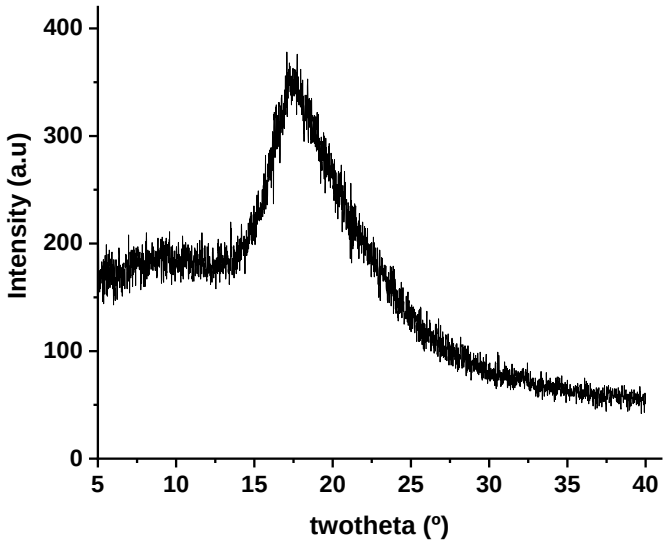


Figure S16 – XRD spectrum of **1-PS$_A$**.

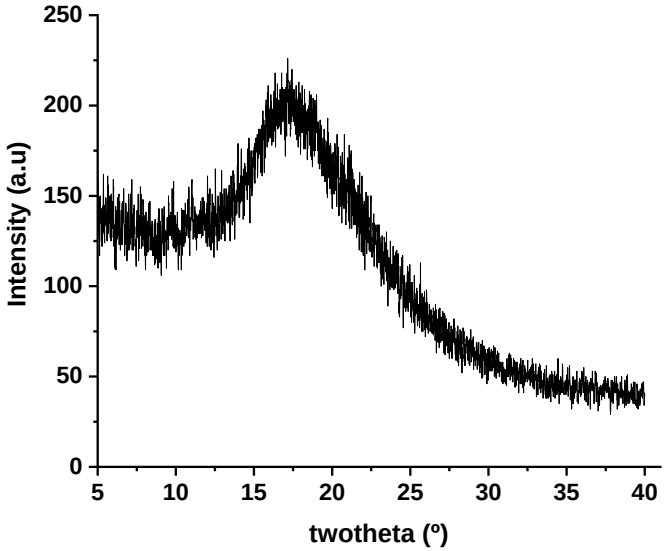


Figure S17 – XRD spectrum of **2-PS$_A$**.

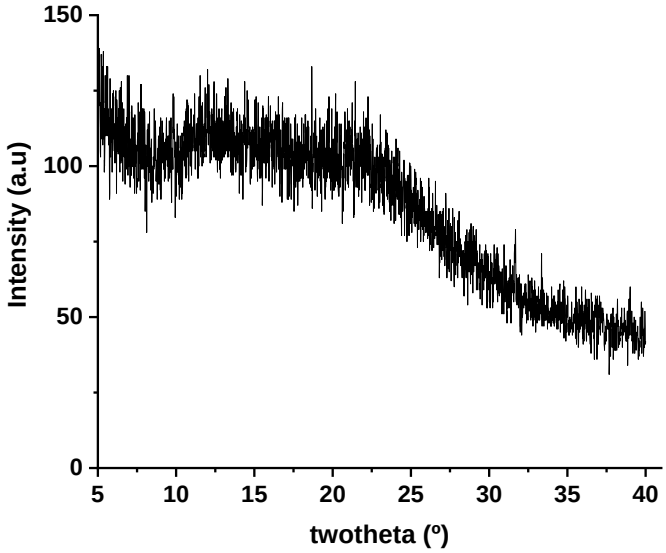


Figure S18 – XRD spectrum of **3-PS$_A$**.

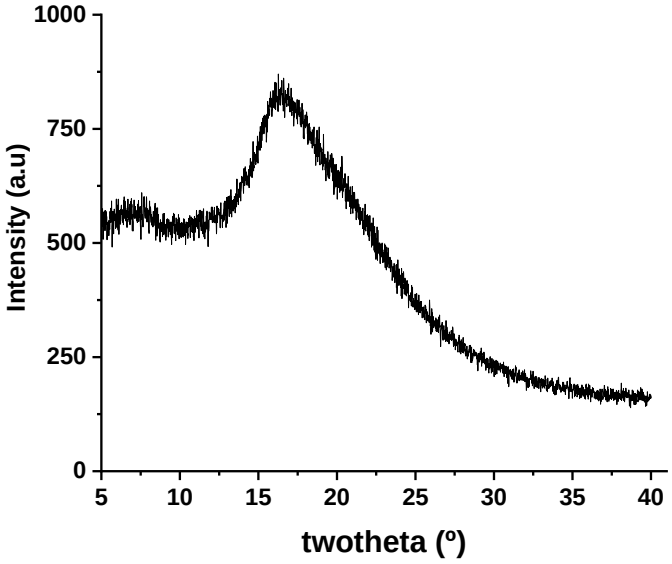


Figure S19 – XRD spectrum of **1-PS$_B$**.

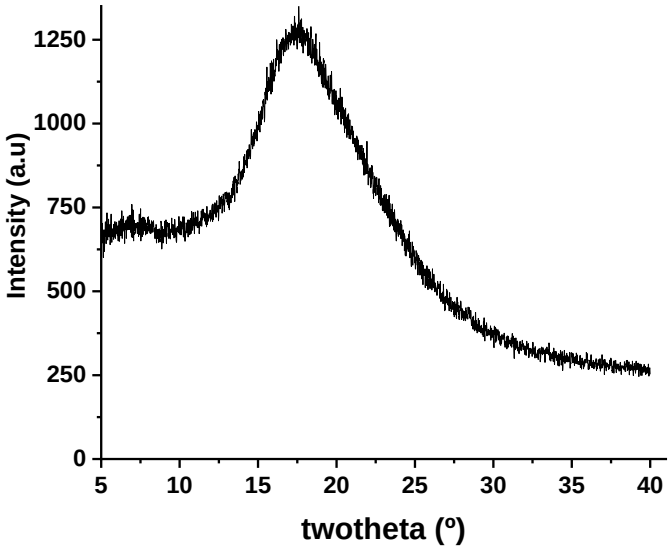


Figure S20 – XRD spectrum of **2-PS$_B$**.

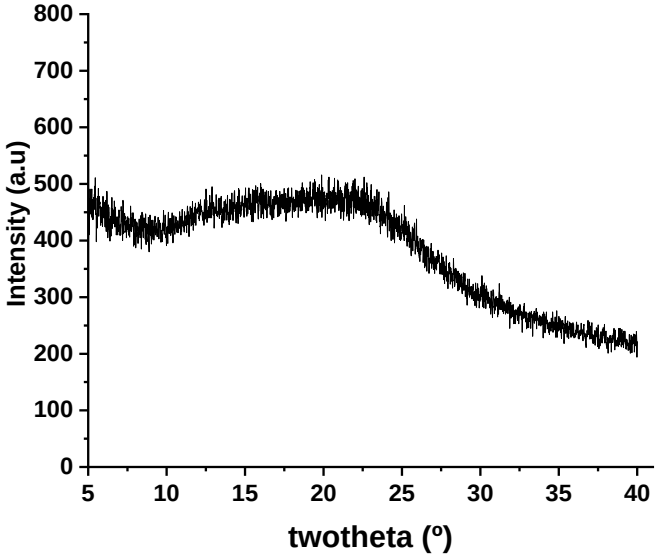


Figure S21 – XRD spectrum of **3-PS$_B$**.

4. Fourier transform infrared spectroscopy (FTIR)

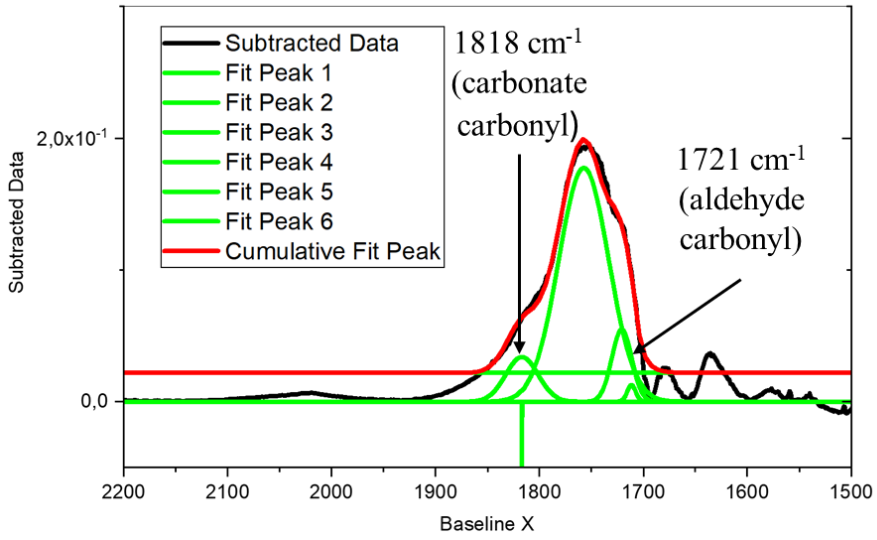


Figure S22 – FTIR spectrum deconvolution of the carbonyl region of **2-PS$_A$**.

5. MALDI-TOF Mass Spectrometry

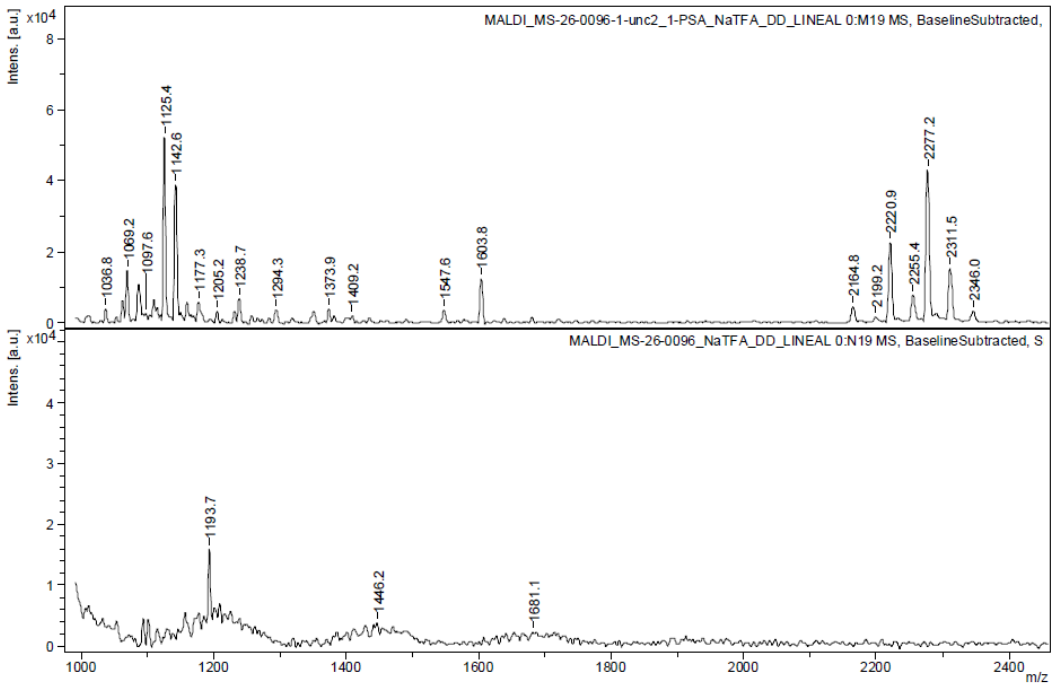


Figure S23 – MALDI-TOF MS spectrum of **1-PS$_A$**, recorded in positive ion mode using DIT (dithranol) as matrix and NaTFA (sodium trifluoroacetate) as cationization agent.

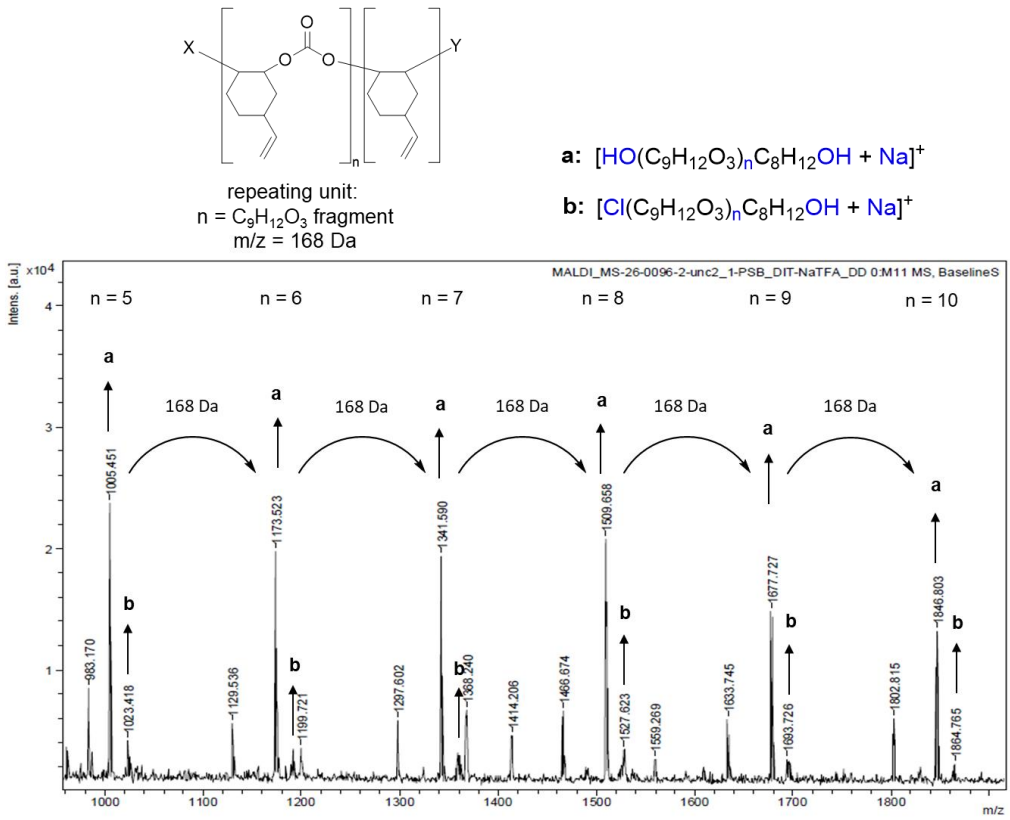
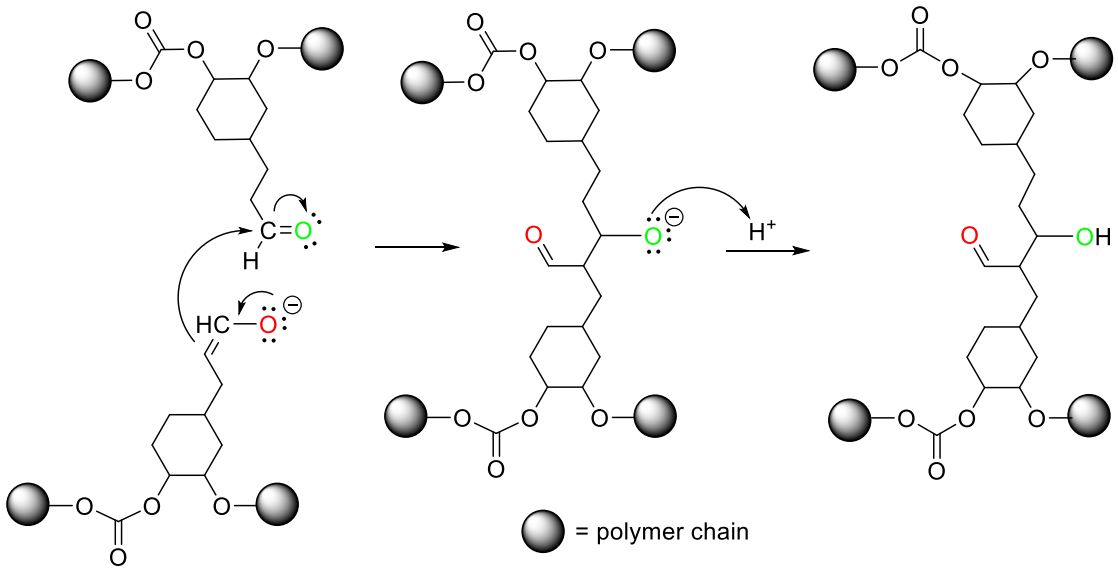


Figure S24 – MALDI-TOF MS spectrum of **1-PS$_B$**, recorded in positive ion mode using DIT dithranol) as matrix and NaTFA (sodium trifluoroacetate) as cationization agent.

6. Formation of cross-linked polycarbonate 2-PS$_B$



Scheme S1. Possible pathway for the formation of cross-linked aldehyde-functionalised polycarbonates.

7. Preparation of ethyl cellulose-polycarbonate biocomposite film

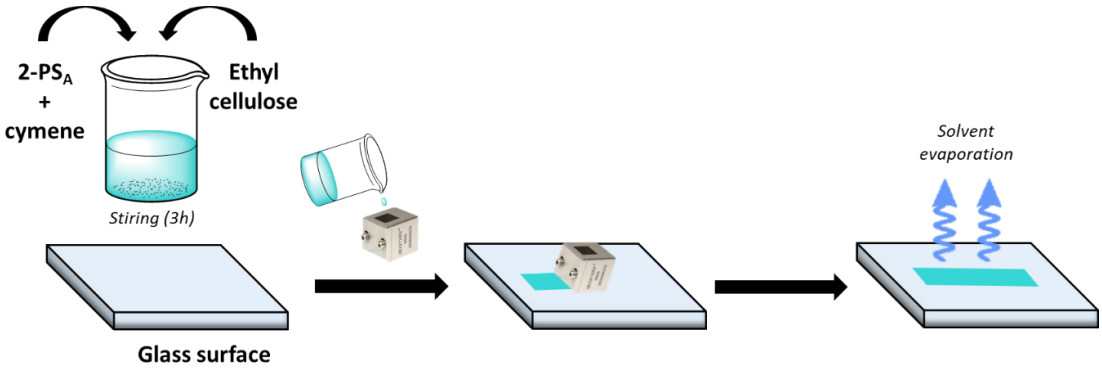


Figure S25. Preparation of ethyl cellulose-polycarbonate biocomposite **2-PS$_{A(15\%)}$@EC**.

8. Antimicrobial Photodynamic Inactivation (aPDI) studies

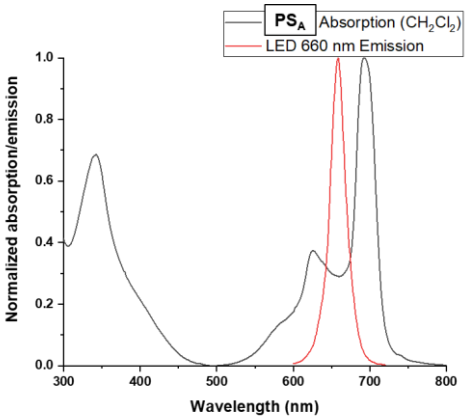
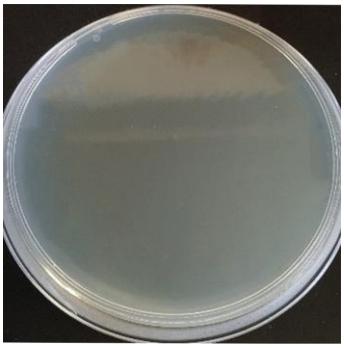


Figure S26. Overlap between 660 nm LED emission and **PS$_A$** absorption in CH_2Cl_2 solution.

Figure S27. Photograph of a 96-well plate containing the samples **1-PS$_A$**, **2-PS$_A$** and **3-PS$_A$**, upon exposure to *S. aureus* bacterial suspensions.

a) Ethyl cellulose (**EC**) without **2-PS$_A$**, after 120 min of irradiation, 49 J/cm^2 (with 100-fold dilution).

b) Biocomposite **2-PS$_{A(15\%)}$@EC** after 120 minutes of dark incubation (With 100-fold dilution)



c) Biocomposite **2-PS$_{A(15\%)}$@EC** after 120 minutes of irradiation – 49 J/cm^2 (Without inoculum dilution)

Figure S28. Representative pictures of Petri dishes obtained for surviving CFU counting in *S. aureus* photoinactivation assays.