Supporting information

Synthesis of model polysulfides

Figure 1SI. $^1$H NMR spectrum of PPS with theoretical overall $DP = 30$, end-capped with ethyl 2-bromoacetate.

Figure 2SI. FT-IR spectra of PPS with variable DP and end-capped with ethyl 2-bromoacetate. The spectra were normalized against the absorbance of the CH$_3$ stretching band at 2959 cm$^{-1}$.
Nanoparticle freeze drying

Figure 3SI. Z-average size of PA4 nanoparticles obtained with a 0.02 Pluronic/PS weight ratio after synthesis and purification (solid squares), after freeze drying of dispersions containing different amounts of sucrose (open circles) and after the removal of sucrose via dialysis (through membranes with 3,500 Da MWCO, open triangles), which provided nanoparticles virtually indistinguishable from the starting ones.

Nanoparticle oxidation

Figure 4SI. Comparison of FT-IR spectra of PPS nanoparticles (Z-average size: 160 nm) before and after 4 h oxidation with H2O2 (15% wt.). The spectra were normalized against the CH3 stretching band at 2958 cm⁻¹. With both the PA4 (left) and the PBr4 (right) cross-linkers, the main spectral difference is the appearance of an S=O stretching band (arrow). The carbonyl band shows an increase in strength, which may be due to hydrolytic processes (the stretching of a carboxylate can be stronger than that of an ester and can be localized in the same spectral area) although the higher polarity of the environment may play a role too. However, the increase is very moderate if other bands are used for normalization.
Figure 5SI. Fluorescence emission intensity of Nile Red-loaded PA_4 (left) and PBr_4 (right) nanoparticles vs. H_2O_2 concentration and time (excitation at 540 nm, emission at 620 nm; 1:25000 Nile Red/thioether molar ratio). Although a higher fluorescence intensity can be detected for the second kind of particles, the kinetic behavior is substantially identical.

Table 1SI. T_2 relaxivity measurements of PA_4 nanoparticles (50 nm in Z-average size). The relaxivity of the protons associated to the methyl group on the PPS chain and the relaxivity of the protons associated to the CH\textsubscript{2} of PEG and CH\textsubscript{3} of PPG of the surfactant, Pluronic F127, were measured on untreated nanoparticles and on PPS nanoparticles, 3 h after being treated with 5% H_2O_2.

<table>
<thead>
<tr>
<th>Polysulfide</th>
<th>Pluronic</th>
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<tbody>
<tr>
<td>CH\textsubscript{3} (1.5/1.6 ppm)</td>
<td>CH\textsubscript{2} (3.7 ppm, PEG)</td>
</tr>
<tr>
<td>untreated</td>
<td>43 ms</td>
</tr>
<tr>
<td>5% H_2O_2</td>
<td>934 ms</td>
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Figure 6SI. Oxidation of PBr₄ nanoparticles in deionized water (0.32 mg/mL) at 37 °C and pH = 7.4.  

**A.** Optical density at 600 nm (solid lines) and Z-average size (open circles) of nanoparticle dispersion vs. H₂O₂ concentration and time. As expected on the basis of the higher hydrolytical lability of the PBr₄ esters, signs of solubilization (drop both in size and in scattered intensity) were recorded after 220 minutes exposure to 15% wt. H₂O₂; however, FT-IR analysis did not show appreciable presence of carboxylate groups (flat baseline below 1700 cm⁻¹) either after 220 minutes with 15% or after 24 h with 10% wt. H₂O₂, suggesting that the “solubilization” process is likely to initially produces branched polymer structures (= a few cleaved esters would be necessary for solubilization).  

**B.** Comparison of FT-IR spectra of the nanoparticles before and after 4 h oxidation with H₂O₂ (15% wt.) or OCl⁻ (10 mM). The spectra were normalized against the CH₃ stretching band at 2958 cm⁻¹.