Investigating the Viability of Sulfur Polymers for the Fabrication of Photoactive, Antimicrobial, Water Repellent Coatings

Electronic supplementary material (ESI†)

Fig. S1 Stacked FTIR spectra of PER-sulfur polymers (50-90 wt % sulfur), where peaks that are suggestive of inverse vulcanisation are highlighted; reduction in C=C-H (3082 cm⁻¹), reduction in C=C (1643 cm⁻¹) and presence of C-S (704 cm⁻¹).
Fig. S2 $^1$H Nuclear magnetic resonance (NMR) spectra for perillyl alcohol, PER_50, PER_60 and PER_70. Highlighted are chemical shifts corresponding to vinylic and allylic protons present in perillyl alcohol.
**Figure S3** Stacked DSC curves of PER-sulfur polymers (50-90 wt % sulfur). Inset: magnified region (50-125°C) of overlaid curves to better highlight peaks that are indicative of elemental sulfur (melting of crystalline sulfur) at ~105-115°C for PER_80 and PER_90 polymers.

**Figure S4** Stacked PXRD patterns of PER-sulfur polymers (50-90 wt % sulfur) and elemental sulfur.

**Figure S5** Hypothesized structures of sulfur -PER products, containing both branching and linear structures formed from potential hydrogen abstraction of PER.
Fig. S6 Top-down SEM micrographs highlighting the change in surface morphology of PER_50- SiO$_2$ coatings, when the weight percentage of SiO$_2$ nanoparticles was increased from 30 wt % to 60 wt %; (a) PER_50-30, (b) PER_50-40, (c) PER_50-50 and (d) PER_50-60. Scale bars are shown. Red highlighted regions indicate areas where aggregates of uncoated SiO$_2$ nanoparticles likely resided.
**Fig. S7** Top-down SEM micrographs of PER_70-40 (*left*) and PER_70-70 (*right*), highlighting the presence/distribution of elemental sulfur particles that had leached out of the polymer during re-processing. Scale bars are shown.

**Fig. S8** Chemical structure of redox dye, Resazurin, and its reduction product, Resorufin.
Fig. S9 Overlaid UV-Vis absorbance spectra of aqueous resazurin dye droplets (1 mg per 20 mL), removed from the surface of TiO$_2$-FAS after each 10 minute irradiation interval, up to 40 minutes of UV exposure (254 nm, 8W).

Fig. S10 Stacked FTIR spectra of PER_60 (maroon line), PER_60-60 before UV irradiation (red line) and PER_60-60 after 4.5 hours of UV exposure (black line).