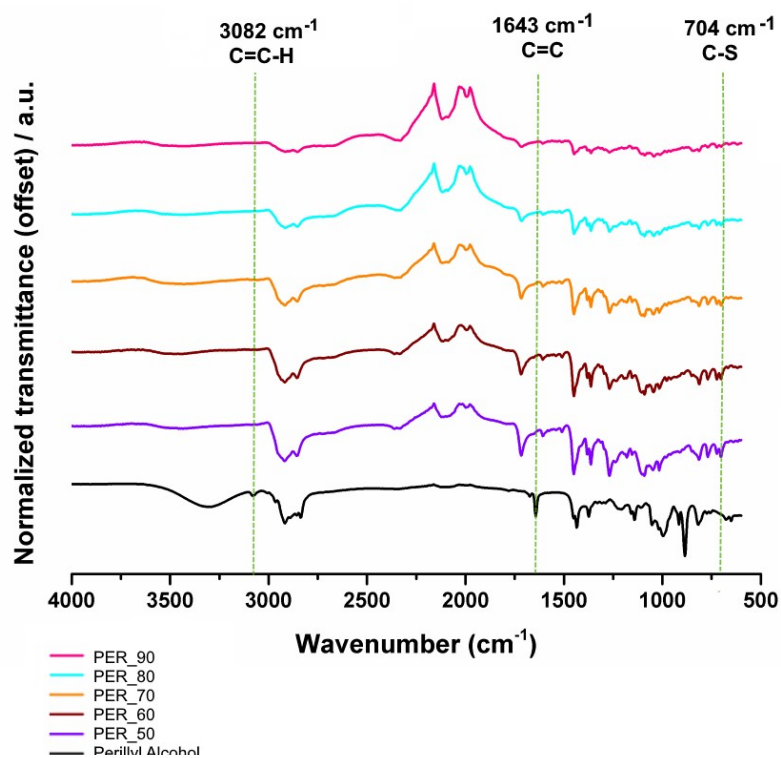
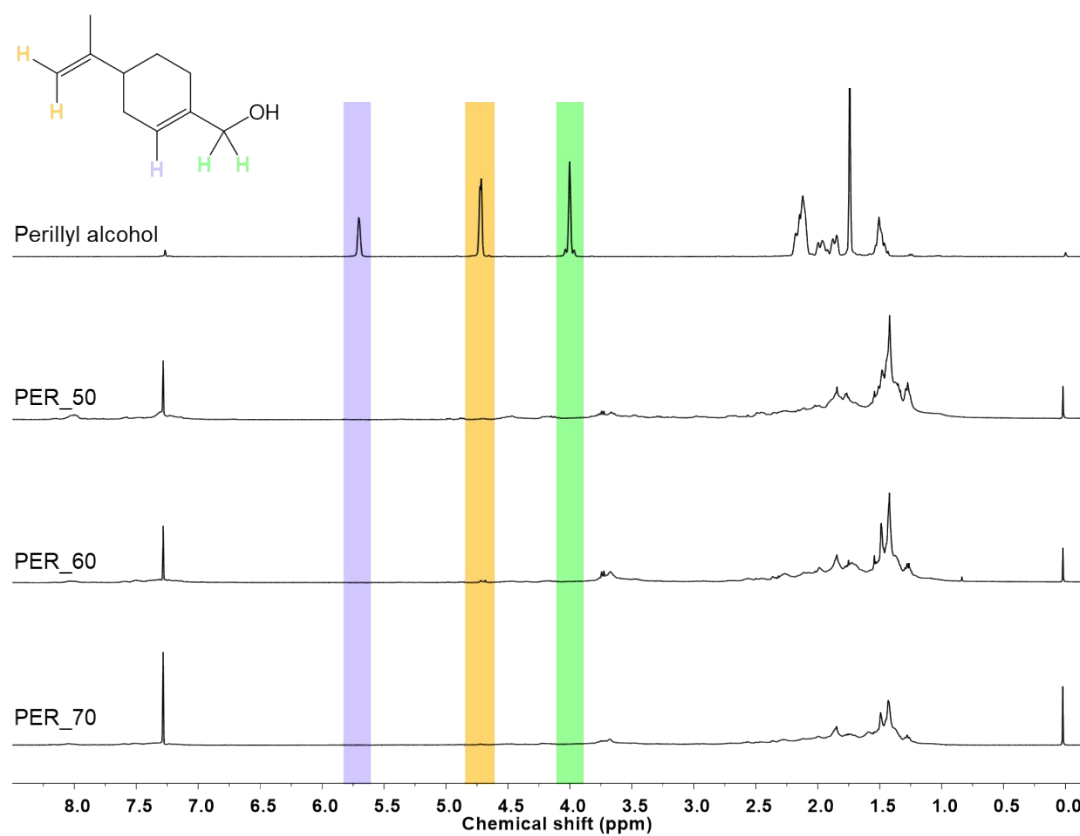


## Investigating the Viability of Sulfur Polymers for the Fabrication of Photoactive, Antimicrobial, Water Repellent Coatings

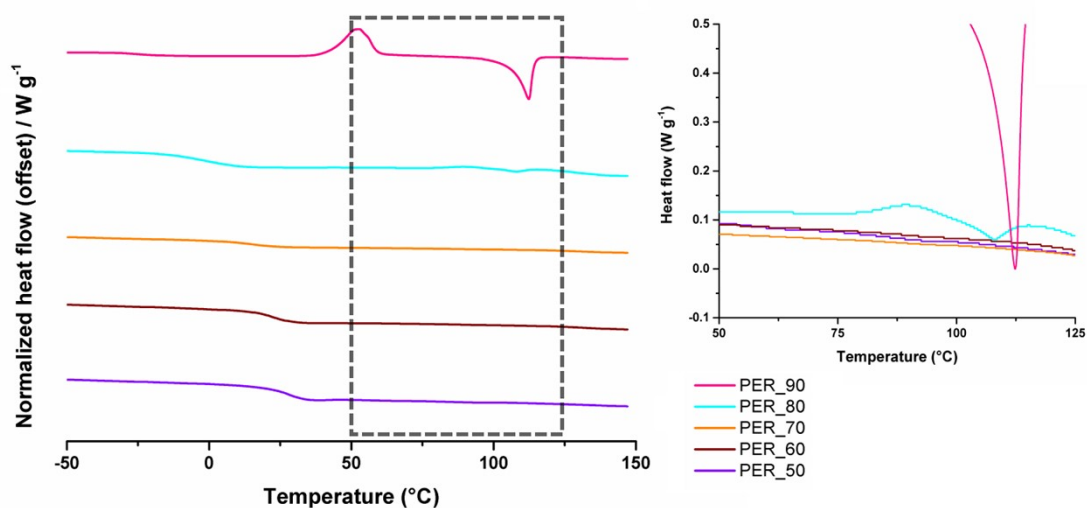
### Electronic supplementary material (ESI†)



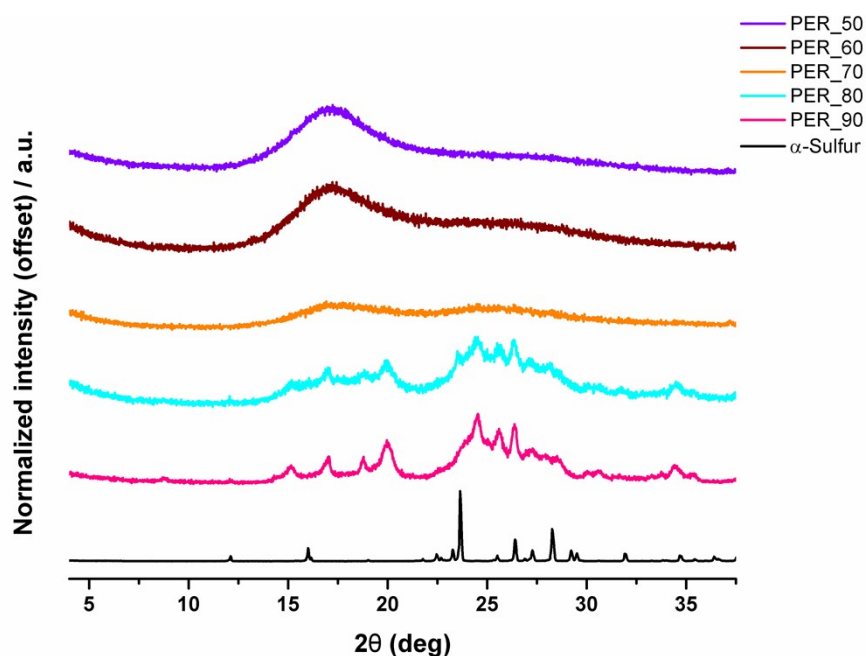
**Fig. S1** Stacked FTIR spectra of PER-sulfur polymers (50-90 wt % sulfur), where peaks that are suggestive of inverse vulcanisation are highlighted; reduction in C=C-H ( $3082\text{ cm}^{-1}$ ), reduction in C=C ( $1643\text{ cm}^{-1}$ ) and presence of C-S ( $704\text{ cm}^{-1}$ ).



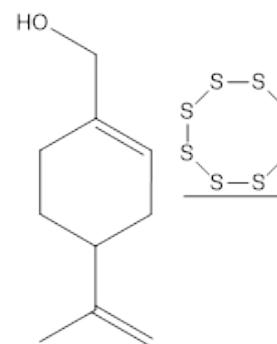
**Fig. S2** <sup>1</sup>H Nuclear magnetic resonance (NMR) spectra for perillyl alcohol, PER\_50, PER\_60 and PER\_70. Highlighted are chemical shifts corresponding to vinylic and allylic protons present in perillyl alcohol.



**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  $\sim 105$ -115°C for PER\_80 and PER\_90 polymers.

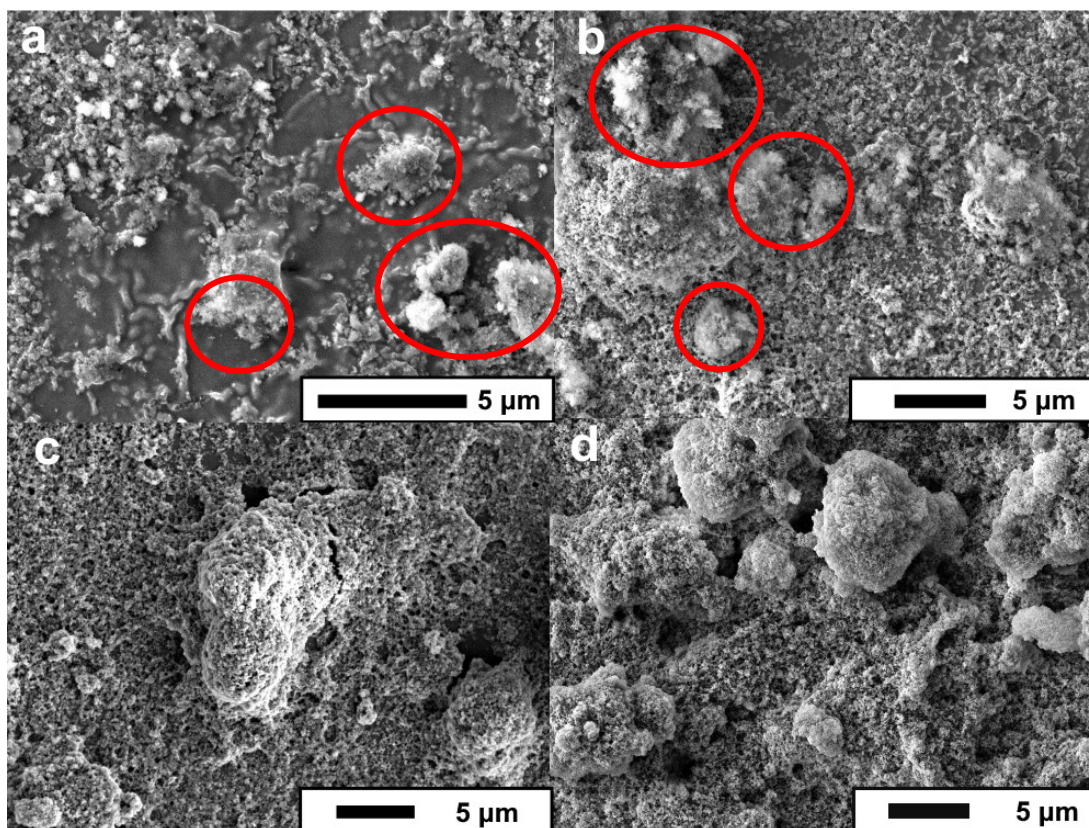


**Figure S4** Stacked PXRD patterns of PER-sulfur polymers (50-90 wt % sulfur) and elemental sulfur.

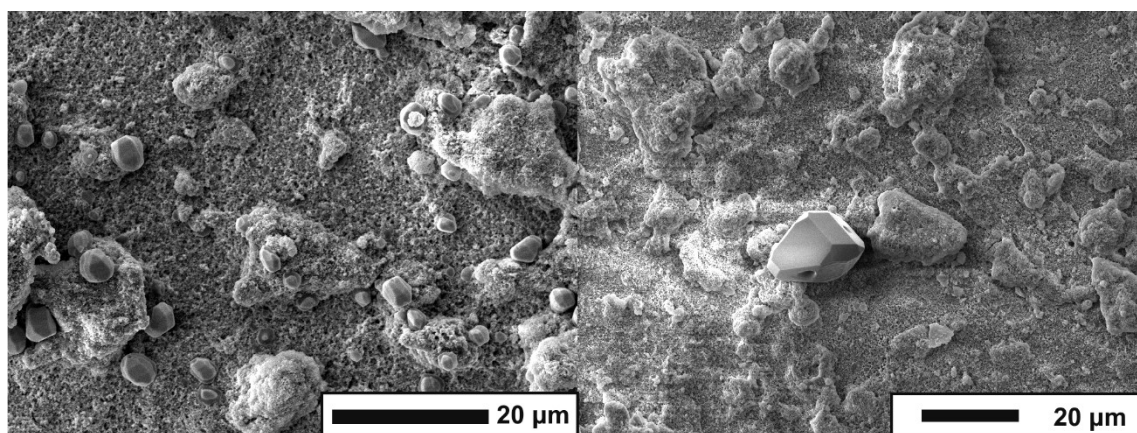


**Figure S5** Hypothesized structures of sulfur-PER products, containing both branching and linear structures formed from

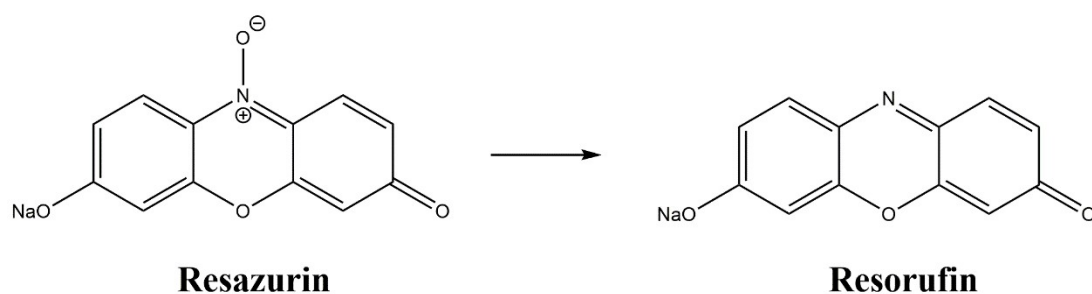
potential hydrogen abstraction of PER.



**Fig. S6** Top-down SEM micrographs highlighting the change in surface morphology of PER\_50- SiO<sub>2</sub> coatings, when the weight percentage of SiO<sub>2</sub> 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<sub>2</sub> nanoparticles likely resided.

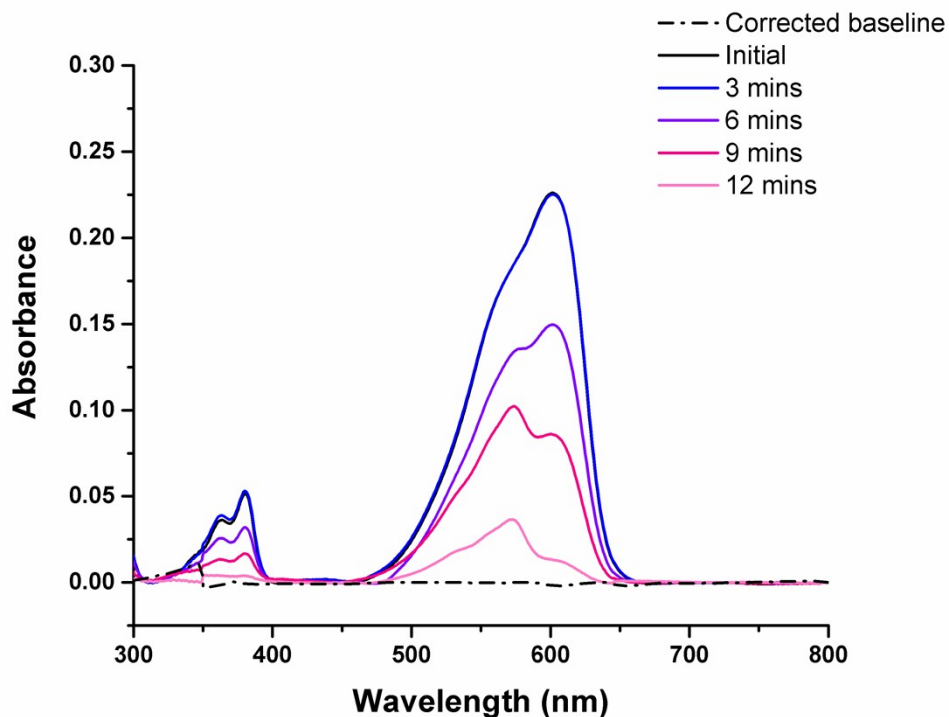


**Fig. S7** Top-down SEM micrographs of PER\_70-40 (**left**) and PER\_70-70 (**right**), highlighting the presence/distribution of elemental sulfur particles that had leached out of the polymer during re-processing. Scale bars are shown.

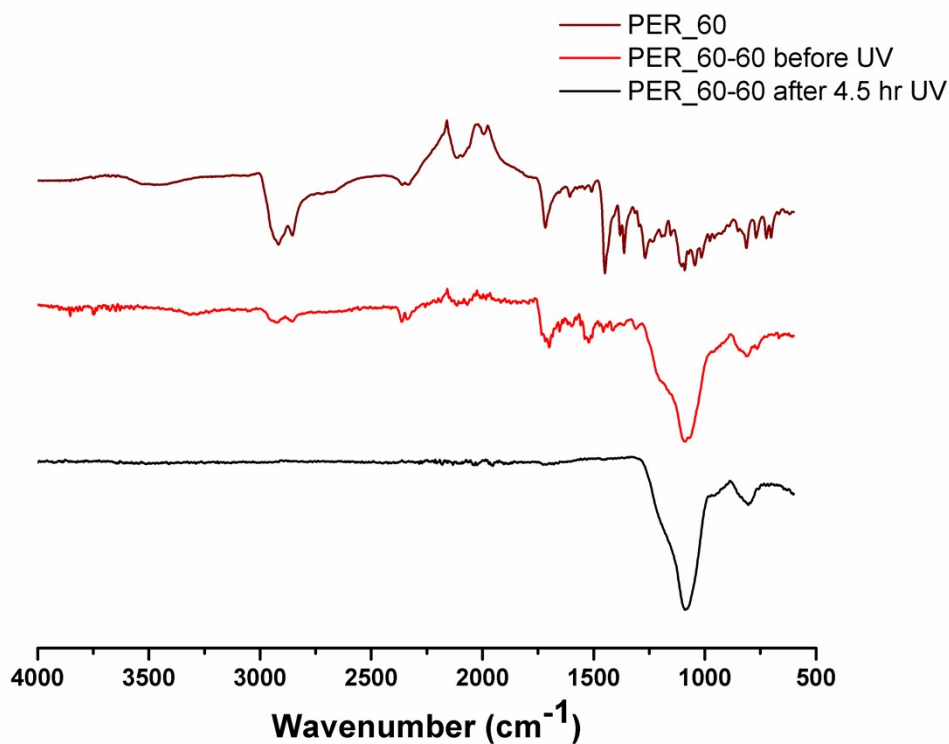


**Fig. S8** Chemical structure of redox dye, Resazurin, and its reduction product, Resorufin.





**Fig. S9** Overlaid UV-Vis absorbance spectra of aqueous resazurin dye droplets (1 mg per 20 mL), removed from the surface of TiO<sub>2</sub>-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).