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Fluorine-Free, Bio-based Antismudge Polyurethane Coating with Enhanced Flame Retardancy

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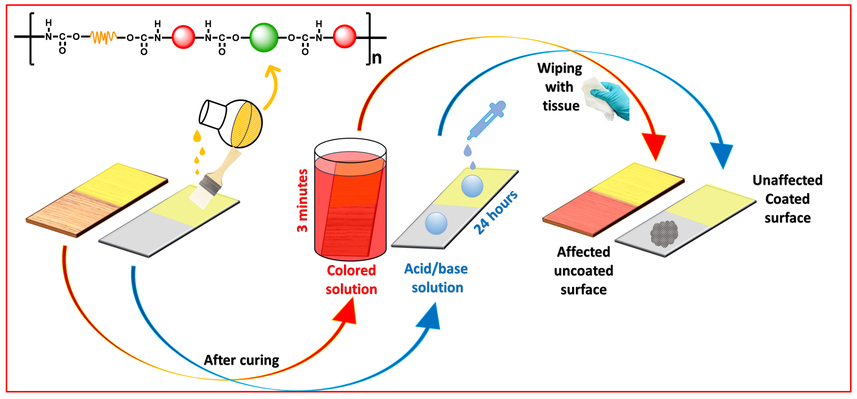
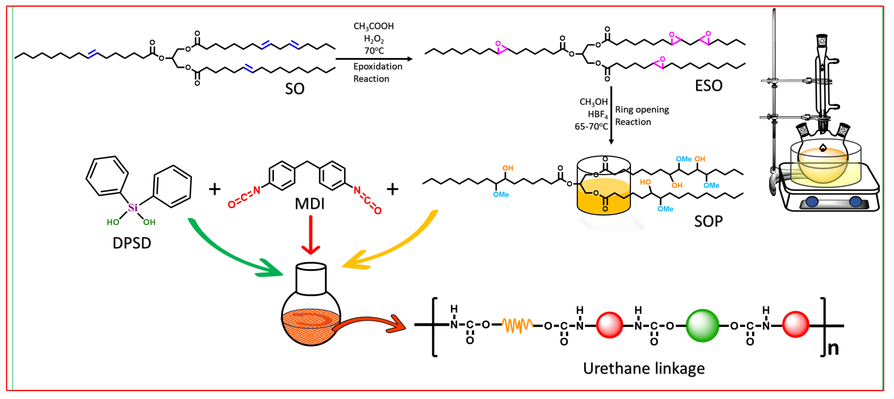
Abstract

Traditional methods for synthesizing coating materials often involve the use of fluorinated reagents, which are not only costly but also hazardous, limiting their use in the 21st century where environmental concerns are paramount. As a result, researchers are increasingly turning to bio-based materials for synthesizing polyurethane (PU) coatings. This study focused on developing an eco-friendly polymer coating to protect wood and metal surfaces. The researchers synthesized the coating by reacting a silicone-containing diol with soybean oil polyol (SOP), aiming to leverage the chemical inertness, resistance to various chemicals, and non-stick properties of silicone to achieve the desired properties of an antismudge coating. The coated coupons, made of stainless steel and oak wood, were tested for resistance to solvents and ink. The coated metal coupon was also subjected to water and solvent drops more than 50 times without any noticeable effect. Additionally, the coating demonstrated excellent durability, with contracted ink being erased by a paper napkin after being written on 1000 times. A burning test revealed that the ignition time increased proportionally with the proportion of Si-containing diol, with the Si-40wt.% sample taking more than twice as long as the control sample to start burning (11 seconds). The weight loss achieved with the Si-40wt.% PU coating material was only 1%. After being immersed in water for 24 hours, these PU coating materials showed no discernible impact, demonstrating their water resistance with a water contact angle of 95°, indicating their hydrophobic nature. Overall, these environmentally friendly materials show promise as candidates for future surface protective coatings.

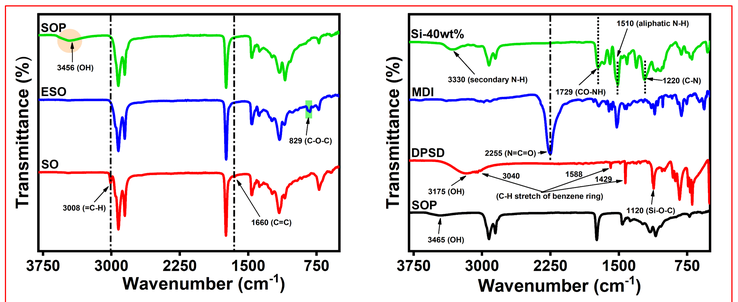
Application

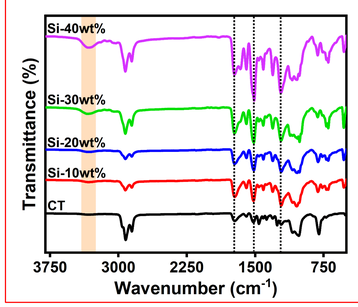


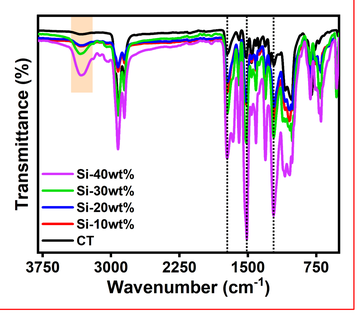
Synthesis

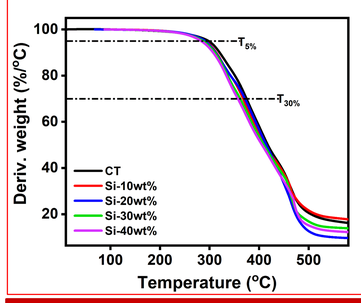


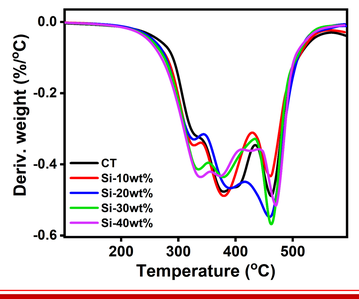
Results

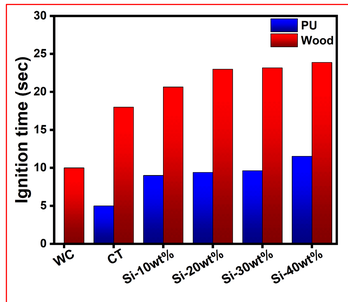


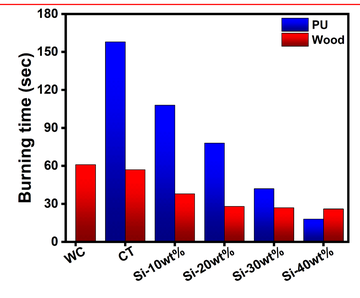


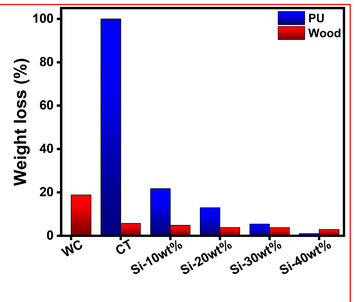


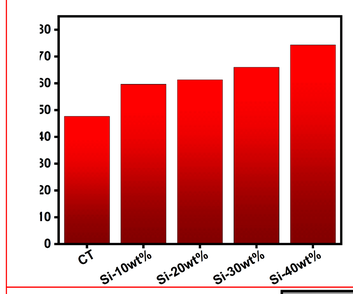


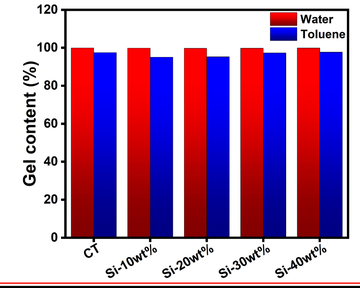


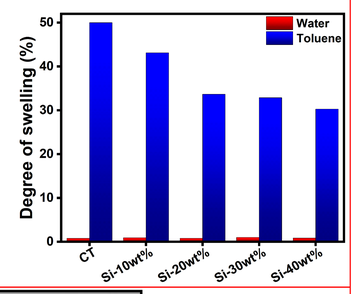


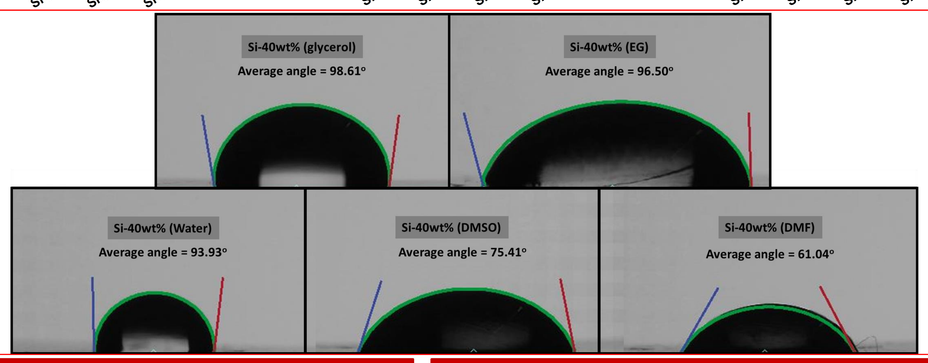


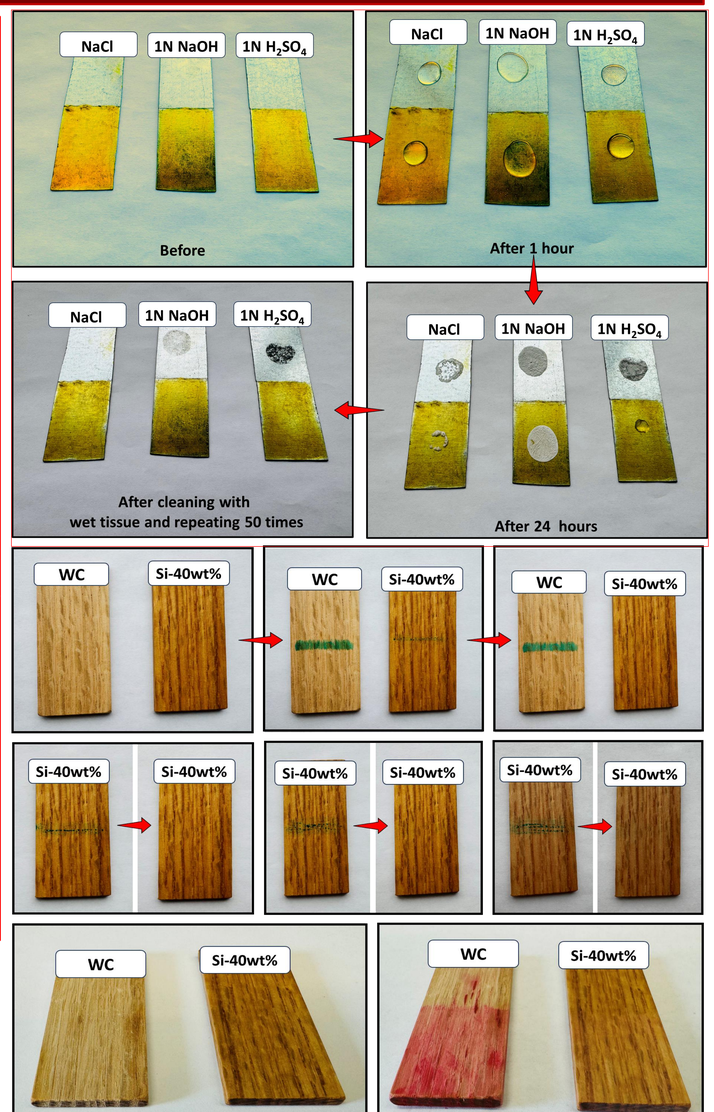












Conclusion

- A bio-based polyurethane coating material was synthesized from soybean oil using a simple method.
- The synthesized coating material exhibits tunable physical and chemical properties suitable for various applications.

Acknowledgements

- National Institute for Materials Advancement
- Pittsburg State University