Next-Generation Coating: Tunable Self-Healing Material for Intelligent Protection of Metal Surfaces

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Metal surfaces are of vital importance in aerospace, automobile, and food industries, where they are often coated to prevent corrosion and chemical reactions with surroundings. Surface defects and mechanical damage of these coatings can lead to severe problems: the release of toxic metals into food poses significant human health risks. My research focuses on developing self-healing materials that automatically repair surface defects through supramolecular interactions, thereby improving the durability and safety of metal surfaces. I have designed and synthesized novel monomers that form hydrogen bonds and salt bridges upon random copolymerization, with their molecular structures confirmed via NMR spectroscopy. Utilizing efficient one and two-component random copolymerization methods, I have produced five polymer resins, specifically polyacrylic acids or polyesters based ones, varying in monomer structure and concentration. These resins were characterized chemically by GPC, DSC, and FTIR analyses. They can be easily applied on metal surface and rapidly solidified within 20 minutes upon heating. Their design allows for the consideration of the component ratio within the polymer network, carefully balancing mechanical strength with self-healing properties. Notably, a polyacrylate resin with a glass transition temperature of 26.31°C and polyesters with a lower polydispersity index (PDI) than commercial materials, were synthesized. Combinations of polyacrylate and polyester resins demonstrated enhanced self-healing ability from scratches and cuts. Future work will explore the design of new monomers and conduct gradient tests on monomer concentrations in polymer networks, further advancing the field of self-healing materials for metal surface protection.

Awards Won:

Fourth Award of $500

King Abdulaziz &amp

his Companions Foundation for Giftedness and Creativity: Full Scholarship from King Fahd University of Petroleum and Minerals(KFUPM) (and a $400 cash prize)

King Abdulaziz &amp

his Companions Foundation for Giftedness and Creativity: NOT TO BE READ -- $400 cash prize for each Full Scholarship from King Fahd University award recipient

Patent and Trademark Office Society: Second Award of $500