Dual-function acid-responsive coatings constituted with dynamic polymer: preparation and performance in antibacterial and corrosion resistance

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Abstract The application of smart polymers in corrosion-resistant coatings has been attracted the focus of researchers because of their responsiveness triggered by the change of external environment, such as pH, temperature and moisture. However, a large number of responsive polymers have complicated structure, which resulted in the inconvenience in their preparation. It contributes to the requirement to constitute new type of smart polymers using simple and efficient synthetic routes. Furthermore, the dynamic polymer system integrated multiple functions is quite necessary in particular application. This work concerns the preparation of the polyacrylates linked with aminophenylpropanthiazole (ABT) as side groups via dynamic imine bonds (Schiff base). One aldehyde-containing monomer (FPHMA) was prepared, and the polymerization of FPHMA and other acrylate monomers was realized in different components proportions. The ABT molecules subsequently were bonded with polymer backbones. The results show the active ABT molecules can be released under a weak acid environment (pH < 5), which coincides with the condition of metal corrosion and microbial reproduction in general. On the contrary, neutral solution cannot lead to the decompose of imine links. The plate count method was used to research the antibacterial efficiency of the smart polymer coatings against *E. coli* and *S. aureus*, which indicates that the antibacterial efficiency up to 99% was obtained. The electrochemical impedance spectroscopy (EIS) data of ABT-containing polyacrylates coatings demonstrates that ABT molecules effectively restrain the corrosion progress of metallic matrix ($|Z|_{0.01Hz}$ was improved by two more orders of magnitudes) due to the controlled release during the immersion in aqueous solution of 3.5 wt% NaCl. After immersion for 72 h, the effect of inhibitor was successfully detected by the method of elements analysis. The synergistic effect of barrier effect of polymer backbones and the active defense by inhibitor ABT provided an effective approach to long-term corrosion resistance.

Keywords: Schiff base, smart polymer, corrosion resistance, antibacterial, controlled release