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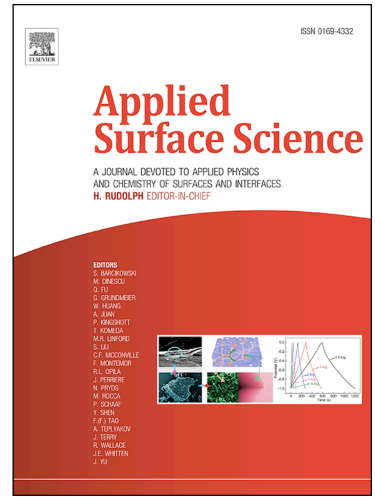

Full Length Article

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Mussel-inspired superhydrophilic surface with enhanced antimicrobial properties under immersed and atmospheric conditions

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Abstract

In this work, a multilayer antibacterial and antifungal superhydrophilic film was prepared on the 316L stainless steel surface by mussel-inspired depositions of polydopamine (PDA) and silver nanoparticles (Ag NPs) followed by modification with methoxy-polyethylene-glycol thiol (mPEG-SH, MW5000). The results of the scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS) indicated that the critical hierarchical micro/nanostructures were mainly constructed by the combination of PDA and Ag NPs. After modified with mPEG-SH, the resulting surface showed excellent superhydrophilicity with a water contact angle of 0°. Further, the as-prepared superhydrophilic surfaces exhibited enhanced and more durable antibacterial performances against the Gram-negative *Escherichia coli* and the Gram-positive *Staphylococcus aureus* under immersed environments. More importantly, the superhydrophilic surfaces also showed excellent antifungal activities against the fungi *Penicillium F2-1* under atmospheric environments. The enhanced antimicrobial properties were resulted from the synergistic effects of anti-adhesion property of absorbed water layers, bactericidal property of Ag NPs and stereo hindrance effect of mPEG-SH molecular chains.

Keywords**:** superhydrophilic surfaces; antimicrobial surfaces; bacteria; fungi

Introduction

316L stainless steel has been widely used as orthopedic implants because of its good mechanical property and corrosion resistance. However, the colonization and proliferation of bacteria on these implanted 316L stainless steel surface easily lead to serious infectious diseases and even death. To solve this problem, antibacterial materials have been developed from the initial antibiotics to the later antibacterial surfaces in the last few decades [1-3]. Because of the excellent bactericidal activity, metallic nanoparticles of silver (Ag), copper or zinc have been incorporated into the development of antibacterial surfaces [4-6]. Silver nanoparticles (Ag NPs), in particular, were the most widely used in the preparation of antibacterial surfaces to prevent the bacteria attachment and kill bacteria [7-9]. The bactericidal property of the Ag NPs was mainly relying on the release of Ag ions, which destroy the