

Abstract

Towards the Development of Sustainable Antimicrobial Surface Coatings [†]

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With the increasing trend of hard-to-treat microbial infections, including multiresistant nosocomial infections, food-related outbreaks, and the rapid spread of potentially infectious microbes in the common spaces of densely populated areas, awareness of the importance of proper systemic hygiene practices has increased. One of the main routes of potential pathogen transmission to vulnerable hosts is via contaminated surfaces. Therefore, the introduction of antimicrobial surface materials may be considered as a potential preventative solution in infection hot spots. Similarly to disinfectants and other hygiene products, the global market for antimicrobial surface coatings is increasing with an annual rate of 10% and is projected to reach USD 7 billion by 2027 [1]. Although other experimental formulations have been used in antimicrobial surfaces, silver, copper, titanium dioxide, and zinc are still the most frequently used active agents [2]. Compared with traditional antibiotics, such metal-based antimicrobial agents have a broad mode of action, which should theoretically prevent the emergence of antimicrobial resistance—a process that has been detected very frequently in the case of antibiotics. Yet, various types of metal-resistance mechanisms in microbes have been described in association to polluted industrial areas and metal mining sites [3]. Furthermore, recent evidence suggests that the appearance of metal resistance may also be linked to the emergence of antibiotic resistance [4], and that such resistant phenotypes may be selected in the presence of sublethal levels of stressors, including various antimicrobial agents [5]. Therefore, ensuring the safety of antimicrobial formulations, and their specific applications in terms of reducing their potential to induce antimicrobial resistance or tolerance, is of great importance when developing sustainable antimicrobial materials. In this work, we propose a strategy to determine the potential of antimicrobial surfaces to induce resistance or tolerance either by enhanced mutation frequency and subsequent selection of resistant mutants or by exchange of genetic material. Along with the fact that such information is required to commercialize biocidal products in the European Union [6], we believe that the proposed framework can be used to ensure the long-term safety and sustainability of antimicrobial surfaces.



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