UNVEILING THE TRUE ANTIMICROBIAL POTENTIAL OF SOLID SURFACES IN SIMULATED WEAR AND TEAR CONDITIONS

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To combat pathogenic bacteria, there is a constant need for the development of effective antimicrobial coatings for frequently touched surfaces. In addition to ensuring sufficient antimicrobial activity, such surfaces should also be meaningfully resistant to wear and tear and preserve their effect over extended time periods. The focus of this study was to evaluate the durability of photo-catalytically active antibacterial surfaces across various usage scenarios.[1] Specifically, we applied acrylic matrix embedded UVA-activated ZnO as a surface coating on stainless steel coupons. Further, we treated the surfaces using three different wear and tear protocols to analyse the effect of those treatments on photocatalytic and antibacterial activity under UVA and for control, also in the dark. The three treatments included dry rubbing and wet rubbing that followed EPA suggested standard "Interim guidance for evaluating the efficacy of antimicrobial surface coatings", as well as abrasion with 3000 grit sandpaper. Those surface treatments were meant to imitate everyday touching, cleaning, and aggressive scrubbing. Our results showed that dry and wet rubbing do not significantly affect the photocatalytic activity of the surface coatings, and may even decrease the antibacterial efficiency of surfaces. This might be due to physical removal of topmost acrylic matrix layer and masking the photocatalytically active surface. However, abrasive treatment of surfaces led to an increase in photocatalytic and antibacterial activity under UVA exposure as well as antibacterial activity in the dark. This was likely caused by topological changes on the surface (such as introduction or surface irregularities) and resulting exposure of new photocatalytically active ZnO material. Increased antibacterial activity in the dark was attributed to higher Zn release from abrasively treated surfaces. Although aggressive abrasion may result in an increased antimicrobial effect for the short-term use, prolonged and repeated abrasion could potentially lead to the damage of the surface coatings. Therefore, we suggest that a preferred method of creating antimicrobially active coatings would involve production of relatively "thick" surface coatings in the case of which repeated removal of topmost layers would be possible. Our study emphasizes a clear need for detailed guidelines on cleaning procedures to be applied on antimicrobial surfaces in order to assure their optimal performance.

References:

1. M. Kook, H. Kaur, D. Danilian, M. Rosenberg, V. Kisand, A. Ivask. Durability of photocatalytic ZnO-based surface coatings and preservation of their antibacterial effect after simulated wear. J Coat Technol Res 21, 1005–1016, 2024.