A biocide silica-titania hybrid coating formulation

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The fast spread of microorganisms such as bacteria and/or viruses may cause particularly harmful situations. Therefore, nowadays, preventing microbiological surface contamination in public spaces is of high priority. The proliferation of a viral or a bacterial infection may arise through air, water, or direct contact with infected surfaces. Chemical sanitization is one of the most effective approaches to avoid the microorganism's proliferation. However, extended contact with chemicals for cleaning purposes such as chlorine, hydrogen peroxide, ethanol… may lead to other long-term diseases as well as drowsiness or respiratory issues,[1] not to mention environmental issues. The coatings presenting antibacterial activity may be due to bacteria adhesion repelling or bacteria killing[2]. In the present work, the bacteria killing strategy was used and the antimicrobial activity is due to the addition of biocides to the coating matrix resulting on active groups exposed on the surface of the coatings.

The coating formulation consists of a hybrid silica-titania-methacrylate matrix where eugenol was added with a double function. On one side, as a complexing agent for the chelation of the titanium isopropoxide precursor of the reaction and, on the other side, as a biocide. Eugenol is an aromatic oily liquid that comes from certain essential oils. Its biocide properties are believed to come from the aromatic rings containing -OH and -OCH_3 groups that provide the compound with antioxidant properties[3,4]. In addition, an ECHA approved biocide (2-Phenylphenol) has also been incorporated to the coating matrix. The effect of coatings containing one or both biocides on gram-positive bacteria (Staphylococcus aureus) and gram-negative bacteria (Escherichia coli) has been confirmed following the ISO 22196:2011 standard: Measurement of antibacterial activity on plastics and other non-porous surfaces. Also, the coatings have been found to have virucidal activity. Moreover, the effect of both biocides on the chemical structure of the coating has been analyzed by ^{29}Si NMR (Nuclear Magnetic Resonance) and ATR-FTIR (attenuated total reflectance Fourier transform infrared), the coating thickness and roughness by means of profilometry and the coating adhesion and mechanical properties by nanoindentation.

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