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Nanotechnology in Conservation of Artworks: TiO2-Based Nanocoatings for the Protection and Preservation of Stone Monuments

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Abstract : The preservation of cultural heritage is a worldwide problem. Stone monuments represent an important part of this heritage, but due to their prevalently outdoor location, they are generally subject to a complex series of weathering and decay processes, in addition to physical and chemical factors, also biological agents usually play an important role in deterioration phenomena. The aim of this paper is to experimentally verify applicability and feasibility of titanium dioxide (TiO2) nanoparticles for the preservation of historical (architectural, monumental, archaeological) stone surfaces which enables to reduce the deterioration behaviors mentioned above. TiO2 nanoparticles dispersed in an aqueous colloidal suspension were applied directly on travertine (Marble and limestone often used in historical and monumental buildings) by spray-coating in order to obtain a nanometric film on stone samples. SEM, coupled with EDX microanalysis. (SEM-EDX), in order to obtain information oncoating homogeneity, surface morphology before and after aging and penetration depth of the TiO2 within the samples. Activity of the coated surface was evaluated with UV accelerated aging test. Capillary water absorption, thermal aging and colorimetric measurements have been performed on on coated and uncoated samples to evaluate their properties and estimate change of appearance with colour variation. Results show Tio2 nanoparticles good candidate for coating applications on calcareous stone, good water-repellence was observed on the samples after treatment; analyses were carried out on both untreated and freshly treated samples as well as after artificial aging. Colour change showed negligible variations on the coated or uncoated stone as well as after aging. Results showed that treated stone surfaces seem to be not affected after 1000 hours of exposure to UV radiation, no alteration of the original features.

Keywords : architectural and archaeological heritage, calcareous stone, photocatalysis TiO2, self-cleaning, thermal aging
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