SMART LAYERS BASED ON SILIANS/TiO_2 FOR THE PROTECTION OF NATURAL STONE

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Along with other semiconductors, TiO_2 nanoparticles are widely used in photocatalytic processes due to their superior properties, such as high photocatalytic activity and high chemical stability, excellent optical and electronic properties, low cost, non-toxicity, etc. [1,2].

In the present work, the photocatalytic capacity of TiO_2 nanoparticles on marble surfaces was studied against methylene blue, rhodamine B and methyl orange. After washing and drying, the marble was impregnated with a siloxane-type silanization solution containing TiO_2 nanoparticles. The silanization solution is applied at room temperature, by immersion or by brushing. The treated substrate is impregnated with silanizing agents and then allowed to dry for 24 hours. The solutions used as a silanizing agent can be any compounds of the type $(RO)_3Si–C_aH_b–OH$ such as: 3APTES (3 aminopropyltriethoxysilane) or 3APMES (3 aminopropyltrimethoxysilane). The free thiol group (–OH) will allow the attachment/immobilization of TiO_2 nanoparticles on the treated surface under normal temperature conditions. These compounds have the role of ensuring effective and long-lasting immobilization of nanoparticles with the role of antimicrobial and self-cleaning protection of the treated surface.

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[1] Kanan S., Moyet M.A., Arthur R.B., Patterson H.H. Recent advances on TiO_2-based photocatalysts toward the degradation of pesticides and major organic pollutants from water bodies. Catal. Rev. Sci. Eng. 2020; 62:1–65. doi: 10.1080/01614940.2019.1613323.

[2] Chen X., Mao S.S. Titanium dioxide nanomaterials: Synthesis, properties, modifications and applications. Chem. Rev. 2007; 107:2891–2959. doi:10.1021/cr0500535.