**Highlights**

* In order to enhance the photocatalytic properties of ZnO, ZrO2-doped ZnO nanoparticles were synthesized by a sol-gel method
* Novel ZrO2-doped ZnO-PDMS nanocomposite was synthesized by in-situ reaction and characterized as protective coatings to preserve stone artifacts from bio-deterioration
* The performances of the newly synthesized nanocomposite were analyzed on different stone substrates (Lecce stone, Brick, and Marble), and compared with well-known PDMS
* The new coating (ZrO2-ZnO-PDMS) showed better results when compared to PDMS in terms of self-cleaning effect due to UV irradiation