NEW ENVIRONMENTAL BUILDING MATERIAL WITH SELF-CLEANING PROPERTY

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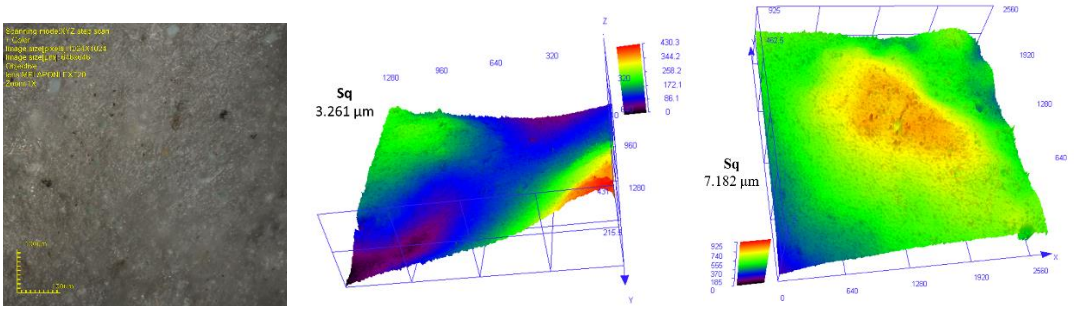
Abstract

Developing self-cleaning building materials has gained a lot of interest among the researchers due to the beneficial effect on the environment regarding the indoor and outdoor air quality and due to the enhancement of the maintenance normally required for the construction materials. A known method for functionalizing the materials is represented by including active components – photocatalytic compounds in the composition of the construction materials. Under the solar irradiation, these materials have the ability to degrade various pollutants coming from the environment, especially from the atmosphere [1]. As materials used for photocatalytic activation, there may be mentioned mortar, cement, asphalt, plaster, glass or even paints [2, 3].

The aim of the present study was to obtain a new building material with self-cleaning property consisting of glass foam as a valuable building material and tungsten trioxide as the photoactive compound. The glass foam is an interesting material which possesses a combination of different properties of value in the construction field such as thermal and sound insulating properties, chemical and mechanical stability and high resistance to fire and moisture [4]. The tungsten trioxide was selected because it has been reported to be a photocatalyst that absorb a wide spectrum of the visible light and because it is cheap and stable in acidic or oxidative environment [5].

The foam glass functionalized with WO_3 was synthetized by hydrothermal method and the raw materials involved are glass waste from household activities, waste of calcium carbonate from marble industry and tungsten trioxide nanoparticles obtained in a previous study by combustion method. The identification of the main chemical elements and bonds of the material was performed by Raman and FT-IR analyses. 3D laser scanning microscopy was employed for characterizing the surface morphology of the material. In figure 1, 2D image and 3D images of the sample at 100 μm and 400 μm scale are presented.



(a) (b) (c)

Figure 1. (a) 2D image and (b) 3D image of glass foam functionalized with WO_3 performed at 20X magnification and (c) 3D image performed at 5X magnification

As a measure of the surface texture, the values of the surface roughness at both scales were calculated for each analyzed surface. The values of the surface roughness are 3.261 μm for image recorded with 20X magnification (figure 1(a) and (b)), respectively 7.182 μm for image recorded with 5X magnification (figure 1(c)).

In order to validate the self-cleaning properties of the glass foam functionalized with WO_3, the material was subjected to a photocatalytic test. In this sense, the capacity of the material to degrade methylene blue (MB) - an organic dye, under artificial solar irradiation was evaluated by recording the absorbance of the MB aqueous solution with UV-VIS spectrophotometer for 2 hours, at every twenty minutes. Former to the exposure to simulated solar light, the material was maintained in the MB aqueous solution (20 ml with initial concentration of 5 mg L^{-1}), in dark conditions, for 20 minutes to reach the adsorption-desorption equilibrium. The decrease of the MB absorbance during the photocatalytic experiment is shown in figure 2. The removal of MB reached a value of 55.5%.

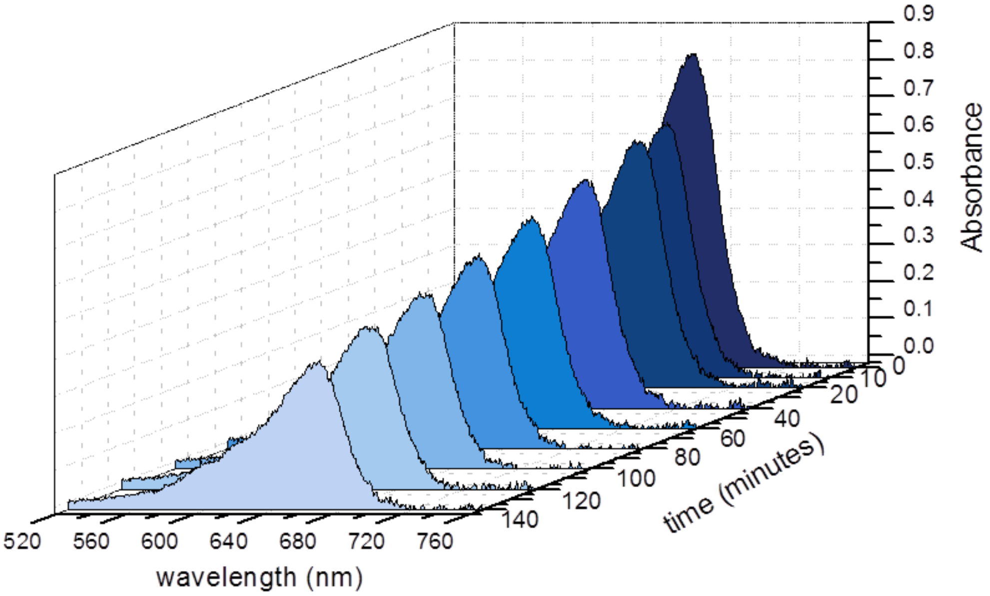


Figure 2. MB absorbance variation in time during the photocatalytic experiment

Acknowledgements

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