Metal oxide nanostructured materials for comfort-living

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ABSTRACT

The time that humans spend in the internal of buildings (workplaces, houses) is increased continuously. As a result, the control of the temperature as well as the air quality are critical parameters for a comfort-living place. In order to create these conditions heating, ventilation and air conditioning (HVAC) systems are used, leading to a huge energy consumption. To overcome this subject, materials that have the ability to enhance the air quality or regulate the internal temperature can be applied in the building sector increasing the energy efficieny of the building. In the present work, ZnO has been employed for the degradation of Nitric Oxides (NOx) gases through photocatalytic process[1], while VO_2 was tested as a thermochromic coating on glazing system[2] in order to control the internal temperature of the building.

NO_2 and NO gases are very common air pollutants both inside a building and in outside the envinroment. They are responsible for a series of dangerous human diseases, mainly conected with the respiratory system. In this study, ZnO coatings were apllied to various substrtates and tested against NOx degradation through photocatalytic process, under UV or visible irradiation. As a result a photocatalytic performance of 70% and 25% under UV and visible illumination, respectively, was succeeded. Finally, the ZnO photocatalytic coatings were applied in the internal of Demo-Houses and tested under real environment conditions, showing similar results.

Another important parameter which is related with the energy efficiency of the building is the control of internal temparure. This can be succeded by applying thermochromic coatings on the top glazing systems that is used in windows, known as “smart” windows. Vanadium dioxide is a well-known thermochromic material, which is infrared (IR) transparent for temperature below T_C = 68°C, while for temperature above T_C it highly reflects the IR radiation. Moreover, it remains transparent in the visible, independent the temperature. In this work, hydrothermaly synthesized VO_2 thermochromic films were deposited on glass substrates via spin coating method. The thermochromic coatings showed T_C = 65°C, IR switching = 10% at λ = 2000 nm and visible transmittance Trvis = 47% at λ = 600 nm.

KEYWORDS: Vanadium dioxide, thermochromic glazing systems, Zinc oxide, photocatalysis

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REFERENCES

[1] V. Binas, D. Venieri, D. Kotzias, G. Kiriakidis. (2017) *Journal of Materiomics*, 3:3-16.

[2] E. Gagaoudakis, E. Aperathitis, G. Michail, G. Kiriakidis, V. Binas. (2021) *Sol. Energy Mater. Sol. Cells.* 220.