Journal of Nano Research
ISSN: 1661-9897, Vol. 81, pp 141-156
doi:10.4028/p-MNLhC3

Submitted: 2023-07-03
Revised: 2023-10-01
Accepted: 2023-10-16
Online: 2023-12-22

Effect of Temperature on Porous Ceramic Substrates Supported ZnO Thin Films for Enhanced Photocatalytic Activity

Khedidja Chehhat[1,a], Abla Mecif[1,b], Abd Elouahab Noua[2,c*], Dogan Kaya[2,d], Lazhar Foughali[1,e], Imed Eddine Zerrouk[1,f], Dhikra Bouras[1,g], Ahmet Ekicibil[2,h]

[1]Laboratory of Active Components and Materials, Department of Materials Science, Larbi Ben M'hidi University, Oum El Bouaghi, 04000, Algeria

[2]Cukurova University, Faculty of Art and Sciences, Department of Physics, Adana, 01250, Türkiye

[a]khedidjachehhat@hotmail.com, [b]mecifabla@yahoo.fr, [c]no.samad@gmail.com, [d]dogankaya@cu.edu.tr, [e]foughali_lazhar@yahoo.fr, [f]zi-74@yahoo.fr, [g]bouras.dhikra@yahoo.fr, [h]ahmetcan@cu.edu.tr

Keywords: Photocatalytic Degradation, ZnO Thin Films, Porous Ceramics Substrates, Sol-gel

Abstract. In this study, eco-friendly and low-cost highly porous ceramic substrates were fabricated to enhance the performance of photocatalysts. ZnO as a model photocatalyst deposited as thin films by dip-coating sol-gel method on naturally extracted kaolin clay (90%) and Corn starch (10%)-made highly porous ceramic substrates prepared as pellet form and sintered at different temperatures: 1150, 1200, 1250, and 1300 °C. The effect of temperature on the prepared substrates modified their porosity and the best value obtained was 56% with a specific surface area of 38.80 m^2/g for 1150 °C. Structural analysis of the X-ray diffraction spectra revealed a hexagonal wurtzite structure for ZnO and mullite/cristoballite structures for substrates. Scanning electron microscopy images confirmed the porosity and uniform formation of ZnO on the substrates. The high porosity samples resulted in a high reflectance of over 90%, and band gap energies values around 3.11 eV were verified by UV–VIS spectroscopy. The photocatalytic properties of ZnO thin films on ceramic substrates were studied by testing the degradation of Orange II dye in an aqueous medium under UV light irradiation. The highest degradation rate of 92% was obtained for ZnO thin films deposited on porous substrates treated at 1150 °C. The kinetic study indicated that the photocatalytic degradation of Orange II correlated with the pseudo-first-order kinetic model.