Enhanced Titanium Dioxide Photocatalyst Embolized on Micropores Silicon Wafer: An Experimental Approach

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ABSTRACT

BACKGROUND: Titanium dioxide's wide bandgap and low activity under visible light have limited its use in many industrial processes. This limitation is associated with the inadequate solar spectrum that activates its surface, where most of the photoexcited electron-hole pairs recombine thus, leading to a drop in the photocatalytic performance. Immobilization of TiO2 on the surface of other materials such as silicon is a suitable approach to overcome these drawbacks. However, the known immobilization methods require either high-temperature or high-pressure conditions. The objective of the present work is to introduce and evaluate a low power-consumption electrodeposition method for creating a new photocatalyst that can act in visible light using electrochemical anodization for immobilizing the titanium dioxide on a silicon wafer surface. Two methods were utilized for immobilization which is electrodeposition and sol-gel. The prepared photocatalyst surface and composition were characterized by SEM, EDX, XRD, and XPS.

RESULTS: The laser-aided electrodeposition method created a unique porous silicon surface after the itching process, where the TiO2 was successfully immobilized on the silicon surface. The resulting SEM images confirmed the formation of 3D-like structures on the silicon surface and that resulted in a higher light absorption efficiency. The methylene blue degradation rate was higher by 60% using the 3-D structured surface when compared with that prepared by the sol-gel method.

CONCLUSION: Unique microstructures were created on the silicon surface by the laseraided electrodeposition method that enables photocatalysis in visible light.

KEYWORDS: Microporous Silicon, Titanium Dioxide, P25, Photocatalyst, Methylene Blue.

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