Controlling the Photocatalytic Activity of Hybrid Thin Films of Titanium Ethylene Glycol (Ti-EG) by Modifying the Thermal Annealing Conditions

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Water pollution causes thousands of deaths each day and destruction of environmental systems. Most available solutions to this problem are inefficient and expensive. A leading solution suggested in recent years is the use of photocatalytic materials, harvesting solar energy to degrade pollutants. Organic-inorganic hybrid thin films of titanium ethylene glycol (Ti-EG), annealed at high temperature, were shown to have excellent photocatalytic properties suitable for degradation of organic molecules when exposed to UV light. So far, little is known about the effects of the thermal annealing process. This study focused on modifying the thermal annealing conditions, specifically the temperature and the atmosphere, and how these changes affect the photocatalytic properties of Ti-EG thin films. Organic dye molecules, modeling the pollutants, were adsorbed to the thin-films. Absorption spectrum of the dye was used to monitor the loading capabilities and photocatalytic properties of the thin films. We observed that the loading capacity is enhanced when the thermal annealing is performed under argon, rather than air. However, annealing under argon results in slower degradation of pollutants by photocatalysis. In addition, we found that while annealing under argon the photocatalytic activity is improved with increasing annealing temperature, annealing under air is temperature independent. These observations are a result of changes in crystal phase, crystallinity, surface structure and electronic structure, which were caused by modification of the annealing process. Tuning of material properties and photocatalytic properties in particular can be used in the future for purification of polluted water and for harvesting solar energy.

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