Optimizing photocatalytic CeO_2 synthesis through design of experiment

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Rapid progress in industrialization in recent years has led to an increase in the release of pollutants into the environment primarily from industrial waste and urban effluents threatening both aquatic ecosystems and human beings.[1,2] Advanced oxidation through heterogeneous photocatalysis is one of the proven methods for the mineralization of refractory organic pollutants such as dyes, pharmaceutical residues, and pesticides.[3–6] The objective of this work is to synthesize innovative photosensitive composite materials based on metal oxides capable of achieving the complete mineralization of these compounds rapidly. Modern developments in nanotechnology have allowed to improve the performance of photocatalytic processes owing to higher surface areas and efficient charge separation in semiconductor nanomaterials. Among the semiconductor studied, cerium oxides remain underexplored even though they could provide efficient visible-light absorbing photocatalysts. In our case, we want to synthesize a composite formed by two semiconductors, one of type p and one of type n, to create a p-n heterojunction and thus achieve superior photodegradation performance compared to the semiconductors taken separately. Cerium oxide is a good candidate as a n-type semiconductor, notably due to its stability at room temperature. We created a design of experiment to optimize the synthesis of cerium oxide, identify key factors influencing the synthesis, and understand the underlying mechanisms. Four factors will be studied: pH, precursor concentration, surfactant concentration and nature of the reaction medium. The aim is to comprehend the impact of these factors on the crystallinity, morphology, gap energy, and photodegradation performance of the synthesized oxides.

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