The Perfect Crystal Is the Imperfect One: A Novel Approach for Utilizing Surface Oxygen Vacancies on Crystalline Cerium(IV) Oxide To Promote Catalytic Ozonation for the Removal of BPA in Wastewater

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High production levels of polycarbonate plastics and canned food have contributed to the leaching of dangerous levels of Bisphenol A (BPA) in wastewater. As an endocrine disruptor, BPA exposure has been shown to negatively affect the development, growth and survival of marine organisms. With the increased consumption of BPA, it has become a priority for wastewater treatment plants to remove the organic contaminant from their water supplies. Previous studies have shown ozonation to be an applicable method for the degradation of organic contaminants such as BPA, however, the objective of this study was to improve the overall efficiency of the ozonation process. A catalyst, crystalline ceria (cerium (IV) oxide), was added to stock solutions of BPA and ozone gas was bubbled through the solution, resulting in 56% degradation of organic carbon during the 60 min ozonation period. Crystalline ceria catalyst was selected in this novel approach as its surface is known for its numerous imperfections, with each surface defect representing an oxygen vacancy - an activation site for the production of the hydroxyl radical oxidant. Pre-treatment of the ceria with UV light was hypothesized to increase the efficiency of the degradation process by increasing the number of surface defects on the ceria crystalline surface. The results supported this hypothesis with degradation levels increasing proportionally with the length of UV exposure. Only 4% of organic carbon was left after 90 minutes of exposure of the ceria to UV light and the subsequent ozonation process. The perfect crystal is indeed the imperfect one!