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Mineralization of the antineoplastic drug carboplatin by heterogeneous photocatalysis with simultaneous synthesis of platinum-modified TiO_2 catalysts

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HIGHLIGHTS

- TiO_2 photocatalytic oxidation of platinum anticancer drug carboplatin was studied
- Photo-reduction of Pt ions occurred simultaneously with photo-oxidation of the drug
- For TiO_2/UV-A, 100% deposition of Pt is achieved within 60 min of photo-oxidation
- Synthesized Pt-modified TiO_2 P25 was more effective compared to the unmodified one

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Abstract

Photocatalytic oxidation of carboplatin, a platinum antineoplastic drug, has been investigated in aqueous heterogeneous solutions containing TiO_2 photocatalysts. The current study, besides the photocatalytic degradation of the drug, examines the utilization of the photo-reduction process occurring on the surface of the catalyst, leading simultaneously to the photo-deposition and recovery of platinum. TiO_2 photocatalytic process was evaluated for its ability to degrade the molecule of carboplatin and concurrently result in the synthesis of efficient platinum modified TiO_2 catalysts. The degradation kinetic was studied under different operational conditions, such as type of photocatalyst, catalyst loading, initial pH and addition of electron acceptors. Three systems were evaluated namely, TiO_2 P25 under UV-A and TiO_2 Kronos vlp 7000 under UV-A or visible illumination, with respect to their activity for substrate degradation and mineralization and their ability to bind platinum on their surface during photocatalytic oxidation of the drug. The initial degradation rate (r_0) decreased in the order TiO_2 P25/UV-A> TiO_2 Kronos vlp 7000/UV-A> TiO_2 Kronos vlp 7000/visible light. For TiO_2 P25/UV-A, the