World Academy of Science, Engineering and Technology
International Journal of Pharmacological and Pharmaceutical Sciences
Vol:17, No:06, 2023

Size and Content of the Doped Silver Affected the Pulmonary Toxicity of Silver-Doped Nano-Titanium Dioxide Photocatalysts and the Optimization of These Two Parameters

Authors : Xiaoquan Huang, Congcong Li, Tingting Wei, Changcun Bai, Na Liu, Meng Tang

Abstract : Silver is often doped on nano-titanium dioxide photocatalysts (Ag-TiO_2) by photodeposition method to improve their utilization of visible-light while increasing the toxicity of TiO_2 However, it is not known what factors influence this toxicity and how to reduce toxicity while maintaining the maximum catalytic activity. In this study, Ag-TiO_2 photocatalysts were synthesized by the photodeposition method with different silver content (AgC) and photodeposition time (PDT). Characterization and catalytic experiments demonstrated that silver was well assembled on TiO_2 with excellent visible-light catalytic activity, and the size of silver increased with PDT. In vitro, the cell viability of lung epithelial cells A549 and BEAS-2B showed that the higher content and smaller size of silver doping caused higher toxicity. In vivo, Ag-TiO_2 catalysts with lower AgC or larger silver particle size obviously caused less pulmonary pro-inflammatory and pro-fibrosis responses. However, the visible light catalytic activity decreased with the increase in silver size. Therefore, in order to optimize the Ag-TiO_2 photocatalyst with the lowest pulmonary toxicity and highest catalytic performance, response surface methodology (RSM) was further performed to optimize the two independent variables of AgC and PDT. Visible-light catalytic activity was evaluated by the degradation rate of Rhodamine B, the antibacterial property was evaluated by killing log value for Escherichia coli, and cytotoxicity was evaluated by IC50 to BEAS-2B cells. As a result, the RSM model showed that AgC and PDT exhibited an interaction effect on catalytic activity in the quadratic model. AgC was positively correlated with antibacterial activity. Cytotoxicity was proportional to AgC while inversely proportional to PDT. Finally, the optimization values were AgC 3.08 w/w% and PDT 28 min. Under this optimal condition, the relatively high silver proportion ensured the visible-light catalytic and antibacterial activity, while the longer PDT effectively reduced the cytotoxicity. This study is of significance for the safe and efficient application of silver-doped TiO_2 photocatalysts.

Keywords : Ag-doped TiO_2, cytotoxicity, inflammtion, fibrosis, response surface methodology
Conference Title : ICT 2023 : International Conference on Toxicology
Conference Location : Paris, France
Conference Dates : June 22-23, 2023