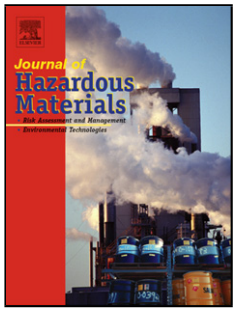

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Author: Xinggang Hou Huiyan Ma Feng Liu Jianhua Deng Yukai Ai Xinlei Zhao Dong Mao Dejun Li Bin Liao

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Synthesis of Ag ion-implanted TiO_2 thin films for antibacterial application and photocatalytic performance

Xinggang Hou[a*], Huiyan Ma[a], Feng Liu[a], Jianhua Deng[a], Yukai Ai[a], Xinlei Zhao[a], Dong Mao[a], Dejun Li[a], Bin Liao[b]

[a]Department of Physics, Tianjin Normal University, Tianjin, 300387, China

[b]Key Laboratory of Beam Technology and Material Modification of Ministry of Education, Beijing Normal University, Beijing, 100875, China

Highlights □

Highlights □ 1. Implanted TiO_2 films with excellent antibacterial and photocatalytic ability was prepared. □ 2. Bactericidal effect of released Ag ions was confirmed using VC as radical scavenger. □ 3. Excitation of TiO_2 to visible region is attributed to subtitutional Ag. □ 4. Synergetic effect of Ag^{3+} and Ag^{+} accounts for the enhanced ability of TiO_2.

Graphical abstract

Abstract

TiO_2 thin films were deposited by spin coating method. Silver ions were implanted into the films using a Metal Vapor Vacuum Arc implanter. The antibacterial ability of implanted films was tested using *E.* coli removal under fluorescent irradiation and in the dark. The concentration of *E.* coli was evaluated by plating technique. The photocatalytic efficiency of the implanted films was studied by degradation of methyl orange under fluorescent illumination. The surface free energy of the implanted TiO_2 films was calculated by contact angle testing. Vitamin C was used as radical scavengers to explore the antibacterial mechanism of the films. The results supported the model that both generation of reactive oxygen species and release of silver ions played critical roles in the toxic effect of implanted films against *E.* coli. XPS experimental results demonstrated that a portion of the Ag (Ag^{3+}) ions were doped into the crystalline lattice of TiO_2. As demonstrated by Density Functional Theory calculations, the impurity energy level of subtitutional Ag was

* Corresponding author.
E-mail address: hou226@mail.tjnu.edu.cn (X. Hou)