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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 TiO₂ thin films for antibacterial application and photocatalytic performance

Xinggong 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

^aDepartment of Physics, Tianjin Normal University, Tianjin, 300387, China

^bKey Laboratory of Beam Technology and Material Modification of Ministry of

Highlights

Education, Beijing Normal University, Beijing, 100875, China

Highlights 1. Implanted TiO₂ 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 TiO₂ to visible region is attributed to substitutional Ag. 4. Synergetic effect of Ag³⁺ and Ag⁺ accounts for the enhanced ability of TiO₂.

Graphical abstract

Abstract

TiO₂ 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 TiO₂ 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 (Ag³⁺) ions were doped into the crystalline lattice of TiO₂. As demonstrated by Density Functional Theory calculations, the impurity energy level of substitutional Ag was

* Corresponding author.
E-mail address: [hou226@mail.tjnu.edu.cn](mailto:houl226@mail.tjnu.edu.cn) (X. Hou)

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