Photocatalytic efficiency of Ag nanoparticles embedded in the $SrTiO_3$ film by R.F. magnetron sputtering deposition

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Abstract

$SrTiO_3$ film and Ag nanoparticles embedded in $SrTiO_3$ film, which is named as Ag(25nm)/$SrTiO_3$ and Ag(22nm)/$SrTiO_3$, are deposited on Si substrates by RF magnetron sputtering system. X-ray diffraction analysis shows the $SrTiO_3$ film has a cubic crystalline structure, so do the composite thin films. However, the (110) diffraction peak shifts toward lower angles for Ag(22nm)/$SrTiO_3$. Moreover, the XPS results show that Ag^+ existed in the $SrTiO_3$ lattice for Ag(22nm)/$SrTiO_3$. This phenomenon would cause lattice distortion and induce stress in the film, which is corresponding to the XRD result and stress measurement. The information of UV-visible spectroscopy indicates the band gap becomes a little bit smaller with the $SrTiO_3$ film embedded with Ag nanoparticles. The photocatalytic result shows that $SrTiO_3$ film has a good photocatalytic decomposition for methylene blue, however, it is a little bad for composite films. The reason of worse photocatalytic efficiency for composite films may be an inappropriate density distribution of Ag nanoparticles. This would be difficult for charge transfer, or electron-hole pairs can not be separated effectively during photocatalytic process. One more reason may be due to the lattice defect which is resulted from Ag^+ ions entering the $SrTiO_3$ structure. This would make the defects become trap-centers to capture electrons. And then a decrease of electron numbers will be occurred for photocatalytic reaction, therefore, the photocatalytic efficiency becomes worse.

Keywords: $SrTiO_3$ film, Embedded, Ag nanoparticle, Photocatalysis.