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Comparison of Pt and Ag as co-catalyst on g-C_3N_4 for improving photocatalytic activity: Experimental and DFT studies

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ABSTRACT

In this work, Ag and Pt were compared as a co-catalyst on graphitic carbon nitride (g-C_3N_4) for the enhanced photocatalytic activity of water spilitting into hydrogen generation. In order to prepare Ag/g-C_3N_4 and Pt/g-C_3N_4, initial adsorption of noble metal ions was performed on the g-C_3N_4 surface, followed by reducing them by using $NaBH_4$. Decoration of Ag or Pt nanoparticles on g-C_3N_4 can extend the visible light adsorption and promote segregation of the photogenerated carriers, which contribute to an improved photocatalytic performance. Pt/g-C_3N_4 has a higher photocatalytic activity in water spilitting for H_2 generation (841 μmol g^{-1} h^{-1}) than that of Ag/g-C_3N_4 (305 μmol g^{-1} h^{-1}), however, almost no H_2 generation for pure g-C_3N_4. For checking the photogenerated holes, •OH generation rate was tested by using the reaction of terephthalic acid (TA) with •OH to form 2-hydroxyterephthalic acid (TAOH). On the basis of experimental results and theoretical calculation, a possible photocatalytic mechanism is put forward. It is suggested that Pt can play a better role as the co-catalyst than Ag can, due to the d-centre of Pt is closer to Fermi level than that of Ag on the g-C_3N_4 surface, which can promote the charge separation and accelerate the electron transformation.

Keywords: g-C_3N_4; Ag or Pt loading; Photocatalytic; Water splitting; DFT calculation

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