Chapter 7
The Recent Design of Ag3PO4-Based Photocatalyst for Renewable Energy and Environmental Applications

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ABSTRACT

Green energy and environmental awareness have grown because human activities have an impact and are harmful to the environment. Recently, renewable energy and the environment are hot issues in the world that are facing serious challenges. A new photocatalyst, Ag3PO4, has great potential to be applied in producing renewable energy and the environment. The recent design of Ag3PO4-based photocatalysts and their applications are discussed in this book chapter. Modifications of Ag3PO4 photocatalysts are carried out to increase photocatalytic activity and stability. Surface modification and composite design into binary, ternary, and quaternary have given very important results in increasing the capability of this photocatalyst. The application of Ag3PO4-based photocatalyst is very prospective for hydrogen/oxygen production, organic pollutant degradation, antibiotic degradation, antibacterial, and environmental sensors.

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INTRODUCTION

The world is currently facing big challenges, especially in the fields of energy and the environment. The use of fossil fuels produces carbon dioxide gas, which influences global climate change. Fossil fuel combustion could have multiple threats to child health due to the emission of toxic particles and gases (Perera, 2017). The toxic air pollutant and climate change affected the developing fetus and young child. Therefore, a future energy source such as hydrogen is very important to replace fossil fuels. Environmentally friendly energy should be provided for our next generation.

To achieve such goals, the photocatalyst is one of the materials that can be chosen to solve energy and environmental problems. Photocatalysts can be applied for hydrogen production under solar irradiation (Wang et al., 2016), converting CO_2 to methanol (Wu et al., 2019), and converting biomass to electricity (W. Liu et al., 2014). These materials can also be applied for wastewater treatment (Arifan et al., 2018; Borges et al., 2016), organic pollutant degradation (Kusworo et al., 2021; Pasini et al., 2021), organic dye oxidation (Ariyanti et al., 2018; Wibowo & Sutanto, 2016), gas pollutant elimination (Sulaeman et al., 2010), and bacteria inactivation (N. Liu et al., 2021; Sutanto et al., 2015). The highest challenge of this material is to produce a highly active photocatalyst under solar light irradiation. With this approach, more sunlight energy could be harvested. The modification of iron-doped TiO_2 (Ebrahimi et al., 2021; Nasralla et al., 2018), nitrogen-doped TiO_2 (Asahi et al., 2001; Hidayanto et al., 2017; Pandiangan et al., 2018; Sutanto et al., 2017; S. Yin et al., 2003), and defect TiO_2 nanomaterials (Ariyanti et al., 2017), have been attempted to achieve this purpose. However, low activity has been found in these materials. Therefore, alternative photocatalysts such as Ag_3PO_4 should be explored. This chapter gives an overview of the latest developments of Ag_3PO_4-based photocatalysts for energy and environmental applications.

Ag_3PO_4-based materials are potential photocatalysts for energy and environmental applications. Ag_3PO_4-TiO_2 heterojunction (C. F. Liu & Perng, 2020), Z-scheme g-C_3N_4/Ag_3PO_4 nanocomposite (Raeisi-Kheirabadi & Nezamzadeh-Ejhieh, 2020), and Ag_3PO_4/MXene (Zhao et al., 2020), have been successful in initiating the water-splitting experiments. These Ag_3PO_4-based photocatalysts could be promising for producing hydrogen as renewable energy in the future. Besides the energy creations, the Ag_3PO_4-based photocatalysts could also be applied for organic pollutant degradation. Colour substances such as methylene blue, methyl orange, and rhodamine B could be easily oxidized by this modified photocatalyst (Yan et al., 2017). Other organic pollutants of phenol (Song et al., 2018), bisphenol (T. Li et al., 2019), and polyaromatic hydrocarbon (Yang et al., 2018) also could be degraded into carbon dioxide and water. For health and sanitary purposes, the Ag_3PO_4-based photocatalysts could potentially be applied as antibacterial agents (Seo et al., 2017).

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