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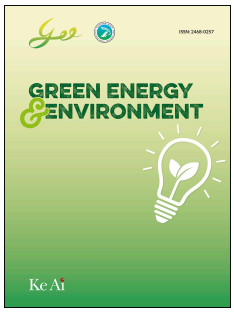

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A Review on Photoelectrochemical Cathodic Protection Semiconductor Thin Films for Metals

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Abstract

Photoelectrochemical (PEC) cathodic protection is considered as an environment friendly method for metals anticorrosion. In this technology, a n-type semiconductor photoanode provide photogenerated electrons for metal to achieve cathodic protection. Comparing with traditional PEC photoanode for water splitting, it requires the photoanode providing a suitable cathodic potential for the metal, instead of pursuit ultimate photon to electric conversion efficiency, thus it is a more possible PEC technology for engineering application. To date, amount of research have been contributed to developing novel n-type semiconductors and advanced modification method to improve the performance on PEC cathodic protection metals. Herein, the recent progresses in this field are summarized, importantly highlights the fabrication process of PEC cathodic protection thin film, various nanostructure controlling, doping, compositing methods and their operation mechanism. Finally, the current challenges and future potential works on improving the PEC cathodic protection performance are proposed.

Keywords: Photoelectrochemical cathodic protection; TiO_2 photoanode; $SrTiO_3$; g-C_3N_4; Photo-electron storage

1. Introduction

Metal corrosion is a quiet destruction. The most of metals in nature have a trend of translate to oxides or stable compounds, except Au, Pt and other noblemetals. So there are very few pure metals in the nature. Engineering metal materials (such as Fe, Al, Cu, Mg, etc.) which extracted from ore or oxide posses strong tendency of return to a stable state. This phenomenon that the metal change back to its metal compound and lost the original metal characteristics in surrounding environmental (such as moisture, temperature, acid, alkali, salt and other chemical substances, etc.), is considered as corrosion. According to the statistics, China's annual economic losses caused by metal corrosions is account for 1.5 ~ 3% of the GDP [1]. The specific hazards induced by metal corrosion are shown in Figure 1-1, including materials wasting, environment pollution caused by the metal ions dissolution and serous engineering safety accidents caused by corrosion.

Cathodic protection is one of the most widely applied technology for engineering metal anticorrosion. It can be classified into two types: impressed current cathodic protection and sacrificial anode protection. The impressed current cathodic protection is that the protected metal will ohmic connect with the negative pole of the external power source, and an inert electrode will connect with the positive pole. Both of them are