

Metal Sulfide Nanomaterials for Environmental Applications

Carbon-metal sulfide nanomaterial photocatalysts for environmental remediation

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Abstract

The combination of transition metals and sulfides creates a class of elite semiconductor materials that are capable of forming important electrochemical reactions under reasonable conditions. These electrochemical reactions have been shown to be beneficial in environmental remediation and other applications. Some metal sulfides have been shown to have an edge over metal oxides, including their narrow band gaps and their sulfur edges with lone pairs which is suitable for photocatalytic reactions. However, metal sulfides have problems associated with photocorrosion and the short lifetime span of the photogenerated charge carriers. There are various ways scientists have implemented to increase the viability of metal sulfides as photocatalysts, in particular, using carbonaceous materials. The formation of hybrid heterostructures between metal sulfides and carbonaceous materials (graphitic carbon nitride) is one of the most studied methods of increasing the separation of charge carriers. The most studied types of heterostructures are Type-I, Type-II, and the p-n junctions, all with their advantages and disadvantages. Characterization techniques such as photoluminescence and transient photocurrent are usually used to demonstrate the usefulness of forming these types of heterojunctions. Apart from the formation of heterojunctions is compositing metal sulfides with conducting carbonaceous materials that do not have a band gap. In this instance, the carbon nanomaterials act as sinks for the photoinduced electrons. In this regard, different types of carbon nanomaterials have been shown to effectively increase the lifespan of the electron and hole pairs including carbon nanotubes, carbon nanofibers, graphene oxide (GO), reduced GO, and biochar, among others.