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Solar-light-sensitive Zr/Cu-(H_2BDC-BPD) metal organic framework for photocatalytic dye degradation and hydrogen evolution

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ABSTRACT

Efficient solar-energy utilization is the future technology to address energy and environmental issues. In this study, we have prepared Zr/Cu based MOF for the mineralization of pollutants and hydrogen evolution from water. The photocatalytic synergism of the prepared Zr/Cu MOF has been investigated from light-controlled studies. Optimized Zr composition has enhanced photocatalytic degradation efficiencies. The present research aims to synthesize novel Zr/Cu-metal based metal organic frameworks (MOFs) by solvothermal (ST) methods and evaluate their photoluminescence (PL) property and photo catalytic activity. Herein, we demonstrate the preparation of tailor-made MOF with solar light sensitive and stable features. The optimized catalyst has shown 94.8% efficiency against the degradation of methylene blue and showed a hydrogen generation performance of 12.5 $mmolg^{-1}h^{-1}$. It was noticed that, concentration of Zr has profound influence on the photocatalysis. Systematic investigation proved that, catalyst has high surface area, metal-organic architecture for improved photocatalytic performance. Further, excellent chemical stability of catalyst after many cycles of reuse would make Zr/Cu-(H_2BDC-BPD) a robust photo-active material.

1. Introduction

Presence of colored contaminants in aquatic systems beyond the permissible levels would create inequity in the ecosystem by eutrophication, thus reducing the light penetration in the water bodies consequently disturbing the aquatic life [1]. Also, production of hydrogen *via* water splitting is an ever intriguing concept for material chemists. In this path, many environmental friendly approaches have been developed using heterogeneous photocatalytic processes for the removal of toxic contaminants and hydrogen evolution from water [2]. There are versatile strategies adopted for the detoxification of waste water like adsorption [3], membrane filtration [4], biological methods [5] etc. Nevertheless, these processes are laborious and lead to secondary contamination which further needs to be addressed. Consequently, photocatalytic technologies are much advanced and facilitate complete removal of pollutants without any secondary contamination [6–10]. In this regard, many materials have emerged like metal oxides [11], sulphides [12], graphene based [13] and carbon based photocatalysts [14, 15]. With due respect these advancements; metal organic frameworks (MOFs) have attracted the attention of many researchers in the field of energy and environment, due to their peculiar properties such as high flexibility and high surface area. Also, presence of metal-organic linkage opens up infinite possibilities for creating efficient, visible-light-sensitive and porous structured materials for the mineralization of organic pollutants and hydrogen evolution in liquid phase [16, 17]. However, potential limitations of the MOFs include poor mechanical strength and weak against energized photons etc. [18]. In order to overcome the potential limitations of the MOFs, several methods are employed such as, post synthesis modifications, pre *insitu* synthesis and synthesis of MOFs based composites [19]. Building MOFs based

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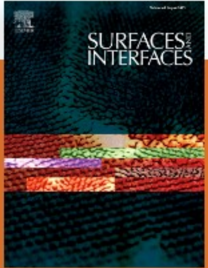

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