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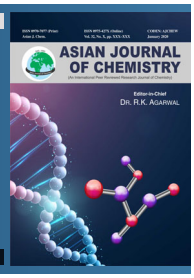

1D MoO_3 Nanorods Decorated by Palladium Nanoparticles: Surface Plasmon Resonance Promoted Photodegradation of Congo Red Dye

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In this work, 1D, MoO_3 palm leaf shaped nanorods decorated by palladium nanoparticle for the photodegradation of organic pollutant. The Pd loaded MoO_3 ratio were optimized and 2% Pd loaded MoO_3 shows excellent photodegradation towards the organic pollutants. The synthesized Pd decorated MoO_3 nanorods were characterized by various analytical tools such as TEM, SEM, BET, EDX, XRD, UV-DRS *etc*., The TEM and SEM results revealed that the palm leaf shaped MoO_3 nanorods was well decorated by Pd metals. The crystallite size of MoO_3 was decreased when increases the palladium loading percentage. The surface area of MoO_3 lowered when palladium loaded. The prepared nanocomposites were in high purity confirmed by EDX analysis. The energy gap tailored into visible region by loaded palladium. The catalytic efficiency of the prepared nanocomposites were tested against the photo degradation of organic pollutant within 60 min and rate constant also calculated. The catalyst was not much lower their activity even five reusability. The OH^- and h^+ (holes) were the active species involved in the photodegradation mechanism.

Keywords: Pd@MoO_3, Surface plasmon, Photocatalyst, Photodegradation, Visible light.

INTRODUCTION

Wastewater effluents discharged from textile industries is a severe threat not only on human life but also on the environment and hence demand suitable remediation technology [1-3]. Especially organic dyes are the compounds that are more stable and most easily recognizable in water system and hence create life threatening situation [4,5]. In this regards, various techniques such as adsorption, membrane filtration, chemical oxidation, biological digestion, electrochemical and advanced oxidation process (AOPs) broadly recognized for the abatement of organic pollutant from water [6-8]. Among these methods, AOPs based semiconductor photocatalytic degradation process has proved to be an efficient and eco-friendly technique compared to the other techniques.

Molybdenum trioxide (MoO_3) is a most noticeable star nanomaterial for environmental treatment due to their structural stability and unique electronic surface properties [9]. MoO_3 is a wide band gap n-type transition metal oxide semiconductor whose conductivity is due to vacant oxygen orbitals [10-12]. In addition, MoO_3 is a polymorph material with at least four crystalline phases such as thermodynamically stable orthorhombic (α-MoO_3), hexagonal (h-MoO_3), metastable monoclinic (β-MoO_3) and high pressure monoclinic (MoO_3-II) [13,14]. Compared to other phases, α-MoO_3 is one of the unique materials because of its excellent electrochemical performance and photocatalytic activities as well as the promising stability [15-17]. However, low quantum yield and higher recombination rate of photogenerated charge carriers (electron-hole pairs), which hampered the wastewater remediation application of MoO_3 in photocatalyst. To solve this problem, several strategies are including heterostructure formation with other semiconductor, metal or non-metal doping and surface modification have been conducted to design or develop new MoO_3 photocatalytic material.

Lately, doping of noble metals (Ag, Au, Pd and Pt) with semiconductor has been receiving considerable attention because it is easy, convenient and effective method for the delay/prevent the recombination and enhancing the stability of MoO_3 [18]. Among them, palladium is one of the promising metals, which