ABSTRACT

Utility of semiconductor photocatalyst is always emerging and crucial research area due to the urgent necessary in safeguarding the environment and produce the alternative energy from solar radiation as well. Minimization of charge carrier recombination is key issues in semiconductor photocatalyst as it's highly influences in overall efficiency. Eventually, the design of hybrid semiconductor with low-dimensional carbon material enhances the charge carrier separation.

In this thesis, we systematically investigated the various types of carbon based two dimensional nanostructured materials preparation and their possible ways to improve the efficiency in semiconductor photocatalyst as a hybrid structure. Two-dimensional materials such as graphene-oxide, graphene and graphdiyne nanostructures are prepared via modified Hummers, microwave reduction and Glaser–Hay coupling reactions respectively. Further, the semiconductor-graphene (graphene-tungsten oxide, graphene-tin tungstate, graphene-zinc sulfide), semiconductor-graphdiyne (graphdiyne-zinc oxide) nano-hybrids are prepared. The hybrid catalyst physio-chemical properties are analyzed by powder X-ray diffraction, Scanning electron microscopy, High resolution transmission electron microscopy, Energy dispersive X-ray spectroscopy, X-ray photo-electron spectroscopy, Fourier transform-infrared spectroscopy, Raman spectroscopy and Photoluminescence analysis.

The catalytic properties are analyzed via organic dye degradation techniques in the presence of light photon. The dye degradation monitored using spectrophotometer and total organic carbon removal analysis techniques. Further, the reaction kinetics analysis performed to understand the reaction quickness with the influence graphene and graphdiyne weight ration. To understand the

photoelectron transfer mechanism between semiconductor and two-dimensional carbon materials, photoluminescence spectroscopy techniques utilized. From photoluminescence spectra, a plausible mechanism has been derived for the photocatalytic enhancement in hybrid nanostructures. We believe that our current insightful investigation expectantly open up new opportunities to use the two dimensional nanostructured materials as hybrid structure with semiconductor to enhance the photocatalytic efficiency.

Keywords: Two dimensional carbon materials, Nanohybrids, Photocatalyst, Recombination.