Abstract

Light assisted organic reaction and degradation of organic pollutants are generally done in expense of high energy UV light, since most of the organic compounds absorb light of short wavelength. Also the UV region coves only near 4% of the natural solar light, while 45% of the energy associated with the visible light. Hence, our focus is centered on the development of new methodologies for visible light assisted photodegradation of organic dye pollutants and selective organic reactions, like reduction, selective oxidation, aromatization, etc. The research works comprised in this dissertation are summarized into four chapters (**Chapter 2 to Chapter 5).** The **Chapter 2** is dedicated for the wastewater treatment, whereas the **Chapter 3**, **4** and **5** are dealing with selective photocatalytic organic reactions.

Further, the **Chapter 2** is sub-divided into two parts (**Part A** and **Part B**). The **Part A** describes visible light assisted photodegradation of persistent dyes (Rhodamine B, Malachite Green Oxalate and Crystal Violet) by a water soluble complex with unknown photocatalytic activity (Fe(III)-salen). The complex chosen is found to be effective in producing both hydroxyl radicals and oxoferryl species in the presence of H_2O_2 under visible light, and it is providing effective degradation of the dyes. The **Part B** describes development of a method for the detection of hydroxyl radicals produced in photo-Fenton processes using benzoic acid as a chemical probe. The methodology is based on hydroxylation of benzoic acid to salicylic acid by *in situ* generated hydroxyl radicals, and the salicylic acid is spectroscopically determined by complexation with Fe(III) ions. In **Chapter 3**, photoreduction of 4-nitrophenol by heterogeneous photocatalyst (Eosin Y dye immobilized resin) is discussed. This method is metal-free, green and assisted by visible light, and the catalyst serves as a carrier of electrons and reusable. The **Chapter 4** deals with a new synthetic protocol for the photocatalytic selective oxidation of benzylic alcohols to corresponding carbonyl compounds with a catalytic amount of solid bromo-reagent (bromodimethylsulfonium bromide, BDMS). Here, the BDMS is utilized as photocatalyst for the first time, and the protocol is genuinely steering the reaction to aldehyde stage. In **Chapter 5**, photocatalytic synthesis of various highly substituted 2-arylpyridines is achieved via Hantzsch reaction using $[Ru(bpy)_3]^{2+}$ (photoredox catalyst) under oxygen atmosphere and visible light. Here, a methodology is established to obtain an unusual Hantzsch product (2-arylpyridine) under the visible light photocatalysis.

Keywords: visible light, photocatalysis, degradation of dyes, reduction, 4-nitrophenol, selective oxidation, benzylic alcohols, Hantzsch reaction, 2-arylpyridines.