CHAPTER 2

SCOPE OF THE PRESENT INVESTIGATION

Recently many investigations have been oriented to the study of the materials at nano scale. The progress in the field of chemistry and material science are heavily dependent on the development of new exotic oxide materials because they constitute a diverse and fascinating class of materials whose properties cover the entire range from metals (even superconductors) to semiconductors and insulators. The study of these oxide materials has attracted the attention of materials scientists due to their interesting and curious optical, magnetic and catalytic properties not only for basic research, but also makes them for technologically useful. One of the prominent material in the metal oxide family is ZnO. Research on ZnO has continued many decades with interest following a roller coaster pattern. The ZnO (II- VI compound) semiconductor has gained substantial interest in the research community in part because of its large exciton binding energy (60meV) and direct wide band gap (3.72eV). Also, ZnO doped with transition metals exhibits the extensive potential applications in various fields. Among the doping and codoping of TM into ZnO has proved to enhance its optical, magnetic, catalytic and antibacterial activity.

An approach with pure ZnO and ZnO (co)doped with Ru and Mn is expected to bring interesting results. The main purpose of Ru doping is to significantly influence the above said activities of ZnO. Also to understand the effect of doping and codoping on ZnO, attempts were made to syntheses pure ZnO, Ru doped ZnO and (Ru-Mn) codoped ZnO nanostructures with
different concentrations by sol–gel method via ultrasonication and characterized. The prime objective of the present study is

- To prepare a nanocrystalline ZnO and Ru doped ZnO (Ru$_x$Zn$_{1-x}$O, where \(x = 0.002, 0.004, 0.006, 0.008, 0.01, 0.02\) and 0.03) and optimizing the effect of dopant concentration by investigating the structural, optical and photocatalytic studies. Congo red (CR) was selected as a representative azo dye to evaluate the photocatalytic performance of Ru doped ZnO.

- To investigate the effect of various dopants such as Ru and Mn on the structural, optical and magnetic properties of ZnO. In order to understand the catalytic activity, selective oxidation of alcohols both primary and secondary in liquid phase with (Ru-Mn) codoped ZnO catalyst along with co-oxidant hydrogen peroxide were performed. Antibacterial activities of the pure ZnO and (Ru-Mn) codoped ZnO against the human pathogens.

As synthesized samples were characterized by using different techniques. X-ray diffraction (XRD) spectra were recorded and analyzed to understand the structural properties. The diffraction patterns were indexed and the physical parameters were determined. In order to understand the morphology and compositions of the samples HRSEM, HRTEM along with EDS were performed and analyzed. Optical properties were studied using UV-Visible and PL spectra and analyzed. The magnetic behaviour of (Ru-Mn) codoped ZnO was measured using SQUID magnetometer.