Preface

The modern world requires huge extent of energy for the generation of electricity, transportation, for industrial processes and communication. For this purpose, we mainly rely on the 'so-called' Fossil fuels, notably coal, petroleum and natural gas. However, this petroleum based energy resources are causing serious affects to the living organisms and the environment by emitting toxic and climate changing by-products. In the current scenario, the use of a clean and renewable energy resource is important for sustainability of the universe. Among the various renewable energy resources like wind energy, hydroelectric energy, tidal energy, biomass energy, solar energy, etc., solar radiation is the most abundant and clean with no harmful effects to the environment.

In the last few decades, a number of efforts have been devoted for the harvesting of solar energy. Including solar cell, a number of technologies have been devised for the conservation of solar energy radiation. The basic idea of a solar cell is to convert light energy into electrical energy. Now-a-days, solar cells based on organic-inorganic hybrid are receiving immense interest due to their less production cost and feasibility of producing flexible devices. Low band gap conjugated polymers like poly(3-octylthiophene) (POT) and poly(9-vinylcarbazole) (PVK) are very promising donor materials in a bulk heterojunction (BHJ) solar cell because of their ease of fabrication, high solubility, high thermal and photochemical stability, etc. A one-dimensional nanostructure such as zinc oxide (ZnO) and/or gold (Au) nanorod is attaining preferable utilization as an electron acceptor in BHJ solar cells as it provides a continuous path for charge transport.

A polymer gel electrolyte based on gelatin can replace the liquid electrolyte in a dye-sensitized solar cell (DSSC). In a nanocomposite based gel electrolyte, the one-dimensional nanostructure such as Au nanorods or multiwalled carbon nanotube (MWCNT) offers improved mechanical, interfacial and conductivity properties to the electrolyte. Moreover, significant electron transport may occur through continuous channel of the nanostructure. Additionally, one-dimensional nanoparticle such as

ZnO nanorod can replace conventional titanium oxide (TiO_2) photoanode in DSSCs as it possesses several attributes including easy fabrication, less toxicity, higher electron mobility, etc. The effect of aspect ratio of the nanostructure on tailoring the device performance may be significant in both types of solar cells.

The present thesis deals with the synthesis and characterization of various aspect ratio zinc oxide (ZnO) and gold (Au) nanorods and finally their application in the field of solid state BHJ and quasi solid state DSSCs. The synthesized nanorods were successfully incorporated into a conducting polymer matrix such as poly(9-vinylcarbazole) (PVK) and poly(3-alkylthiophene) (P3AT) and studied the device performance of these nanocomposites in BHJ photovoltaic device. The contents of the thesis have been compiled into six chapters. Chapter 1 deals with motivation and research background of the present investigation with brief review on different materials used in the study. Chapter 2 describes the effect of aspect ratio of ZnO and Au nanorods on the photovoltaic performance of PVK based BHJ solar cells. Chapter 3 deals with the effect of different aspect ratio ZnO nanorods on the device performance of BHJ solar cells based on POT. Chapter 4 describes the fabrication of a set of quasi solid state DSSCs by using Au/gelatin nanocomposite as the gel electrolyte and studied the effect of aspect ratio of Au nanorods on the device performance. Chapter 5 illustrates the effect of different aspect ratio of ZnO nanorods as a photoanode in a set of quasi solid state DSSCs. The last chapter of the thesis i.e., Chapter 6 describes the conclusion and future scope of the present investigation. The major findings of the thesis are highlighted in this chapter.

We hope that this study contributes a little knowledge to the polymer nanocomposite based organic inorganic hybrid solar cells. At the same time it also opens up the possibilities of further research in this area.

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