PREFACE

Presently, the non-renewable resources are the major energy sources that fulfill the ever-increasing energy demand. However, these non-renewable energy sources continuously damage our environment by emitting harmful gases and materials. Current situation demands renewable and eco-friendly sustainable energy sources without further deteriorating our environment. There are many types of renewable energy sources like solar energy, biomass, tidal, wind, hydroelectric, etc. Amongst them, the energy in the form of solar irradiation coming from the Sun is a highly available, free energy source. To harvest this abundant solar energy, many types of technologies are already in use like solar concentrators, solar heater and solar photovoltaics.

Solar photovoltaics is the conversion of solar energy into electrical energy, and the device which converts this energy into electricity is known as a photovoltaic device. On the basis of different technologies used to fabricate these devices, they are classified into three generations. Silicon wafer based cells are the first generation cells, thin film solar cells are the second generation cells and emerging solar cell technologies comprise the third generation solar cells. Dye sensitized solar cells, fabricated with an electrolyte sandwiched between two electrodes, belong to the third generation solar cells. They have been able to attract more attention in the last couple of decades due to their low cost and easy fabrication technique. Poly(methyl methacrylate) based polymer gel electrolytes incorporating different types of fillers are promising due to their high stability and conductivity. The dye sensitized solar cells can be made even more cost-effective by replacing the costly platinum counter electrode material with carbon based materials like reduced graphene oxide.

This thesis mainly focuses on the synthesis and characterization of different poly(methyl methacrylate) based polymer gel electrolytes with various fillers like polyaniline nanotube, carbon black and carbon dots, and a counter electrode material based on polyaniline and reduced graphene aerogel. The prepared polymer gel electrolytes and graphene based counter electrode are used to fabricate stable and efficient dye sensitized solar cells. This thesis is comprised of six chapters. The first chapter, Chapter 1, contains the general introduction and motivation of the research work. Chapter 2 introduces a new polymer gel electrolyte based on poly(methyl methacrylate) with polyaniline nanotube fillers. Chapter 3 deals with a poly(methyl methacrylate) based polymer gel electrolyte in which carbon black is used as a filler to prepare the polymer blend. Chapter 4 explores the optical properties of carbon dots and illustrates their effect on the efficiency of a dye sensitized solar cell. Chapter 5 presents a polyaniline nanotube and reduced graphene based aerogel as a platinum free counter electrode for a dye sensitized

solar cell. Finally, Chapter 6 summarizes the outcome, overall conclusion of the present work and the future scope.

We hope that this thesis will contribute to the fast growing field of dye sensitized solar cells based on polymer gel electrolytes and platinum free counter electrodes, and open up the new possibilities of further research on this topic.

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