PREFACE

Quantum dot sensitized solar cells (QDSSCs) are highly interesting because of multiexciton generation (MEG) nature that can be used in achieving stable and higher efficiency solar cells. QDSCs, having the advantages of low-cost assembling process, economically viable materials, and intrinsic optoelectronic properties of QD sensitizers, are regarded as attractive candidates for the low-cost third generation solar cells. The collaborative performance of QDSCs is dependent on the charge excitation from the QD sensitizer, injection into the metal oxide (TiO_2), and transport in the circuit, as well as the transfer of the photogenerated holes and regeneration of the redox active electrolyte. The work intensifies the development of highly-efficient electrolyte matrix in the general field of QDSCs. Redox active polymer electrolyte plays an important role to drive reversible and bidirectional charge transport within electronic device i.e., battery and photovoltaic device (solar cell). Redox active liquid electrolyte destroys the device structure due to corrosion, leakage and high penetration. Liquid electrolyte creates poor device performance and durability. Gel polymer electrolyte draws more attention towards electrolytic function because of better adhesion and interfacial contact. Research scientists have developed more number of redox active ionic couples (inorganic / organic couples and complex ions) for Quantum dot sensitized solar cell. Photovoltaic conversion efficiencies were found to be degraded due to poor performance of electrolyte. Recently, Science and technologies have ignited to develop highly efficient gel polymer electrolyte through functionalization, grafting or structural variation. Redox potential and electrical conductivity play a key role to estimate photovoltage of the device. Device efficiency can be improved by tuning the redox potential of electrolyte. Therefore, researchers are trying to develop composite gel polymer electrolyte to enhance the stability and durability of device. Gel polymer electrolytes provide an attractive choice for maintaining good ionic conductivity and reducing the cell leakage problems.

Hence the main objective of thesis is to develop efficient gel polymer electrolyte by using thermoplastic polyurethane ionomer. Thermoplastic pristine polyurethanes does not have sufficient electrical conductivity. However, electrical conductivity can be created through chemical and structural modification around hard segment content in polyurethane chain. By using chemistry, polyurethanes were converted into conductive matrix due to functionalization or grafting of redox active pendant group on urethane linkage. Short chain ionic group structurally modifies the physical properties of native polyurethanes. The ionic pendant group is preferred due to hydrophilic and stabilization efficiency in polyurethane chain. By changing the chemical environment around urethane linkage, redox properties have been tuned. The differential electrolytic (hole conduction) behaviour was observed with better interconnection in composite ionomer structure. Polyurethane ionomers having more oxygenic rich functional groups, showed efficient hole conduction because of greater interaction with nanopores of photoanode. Finally, GO implanted polyurethane ionomers have been developed for Quantum dots sensitized solar cell. The photovoltaic parameters were observed to be improved due to enhanced electrical conductivity and passivation effect of resultant gel polyelectrolyte. The complete synthesis, characterization and photovoltaic studies of the materials in QDSS cell have been discussed in the thesis. In summary, it can be concluded that polar functional groups are observed more efficient in electrolyte structure. The resultant gel polyelectrolyte functions as better substitute of traditional polysulfide electrolyte due to combined effect of redox mediation as well as interfacial passivation effect on photoanode.