PREFACE

Conducting polymer based organic devices are gaining attention in modern electronic sensing technology due to their low-cost and low-temperature fabrication processing, flexible, non-toxic and biodegradable features. Recently, the poly(3, 3‴-dialkylquarterthiophene) or PQT-12, an inherently p-type organic semiconductor, has been projected as a better alternative to the most widely used P3HT polymer due to its better chemical stability, good solubility, easy processability, relatively high field-effect mobility etc. In view of the above, the present thesis investigates the fabrication and characterization of some PQT-12 based organic devices for gas (mainly ammonia (NH_3) and nitrogen dioxide (NO_2)) sensing and photodetection applications. The thesis consists of SIX chapters which are briefly outlined in the following.

Chapter-1 introduces the properties of the conducting polymers, their conduction mechanisms, thin film characterization techniques and importance for sensing applications. A detailed literature survey followed by the scope of the present thesis has been finally outlined in this chapter.

Chapter-2 reports the investigation of NH_3 and NO_2 detection properties of PQT-12 polymer based flexible metal-semiconductor-metal (MSM) device fabricated on a polyamide substrate by spin-coating method with an interdigitated Au-electrode structure on the film. Various properties of the PQT-12 film have also been investigated in details. Gas response, response time and recovery time have been measured and analysed.

Chapter-3 presents a comparative investigation of the NH_3 sensing properties of two organic thin film transistors (OTFTs) using pristine PQT-12 film in one device and

PQT-12/CdSe quantum dots (QDs) composite film in another as active materials. Both the OTFTs have been fabricated on SiO_2 grown Si substrates by spin-coating method. The various electrical and sensing parameters such as the field-effect mobility, threshold voltage and subthreshold swing of the OTFTs have been estimated. Gas response, response time and recovery time of the two OTFTs have also been studied. The better electrical and NH_3 sensing performance of the OTFT with a PQT-12/CdSe QDs composite film over the OTFT with a pristine PQT-12 film have been demonstrated in this chapter.

Chapter-4 investigates the NH_3 gas sensing characteristics of the OTFT using PQT-12 film grown by the floating-film transfer method (FTM) on a SiO_2 coated Si substrate. The surface and structural morphologies of the FTM-based PQT-12 film has also been studied. Finally, the electrical and gas sensing characteristics of the present OTFT have been compared with those of the spin-coated PQT-12 film based OTFT. The best gas response of the present OTFT among all the organic devices considered so far in the previous chapters has been demonstrated.

Chapter-5 investigates the electrical and green-light detection properties of the FTM-derived PQT-12 film based OTFT. The optical properties of the FTM-derived PQT-12 film have been discussed. The photoresponse of the OTFT under study has been measured at ~540 nm incident light with an intensity of 5 $\mu W/cm^2$.

Chapter-6 includes the major findings of the thesis along with a brief outline for the future scope of research related to the present thesis.

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