PREFACE

Ever since the discovery of fullerenes in 1985, synthetic allotropes of carbon or rather carbon nanomaterials including carbon nanotubes, graphene and carbon dots have been extensively used in different applications, ranging from sensors and catalysis to energy storage and conversion. In a sense, one can say that these structures are the primary driving force behind the current nanotechnology boom, a field that has progressed at an exponential rate during the last couple of decades. The interest in carbon nanomaterials stems from their exceptional physical and chemical properties which can be tailored towards a definite type of application.

The aim of this thesis is to exploit the potential of some of the carbon nanomaterials (viz. multi-walled carbon nanotube, reduced graphene oxide aerogel, carbon black and carbon dot) for different applications. Different strategies will be designed for each nanomaterial to be explored separately in a different chapter to highlight a specific characteristic most suited for a particular type of application. Chapter 1 introduces different allotropes of carbon along with relevant areas of application. Chapter 2 focuses on manipulating the high electrical conductivity of carbon nanotubes to design a sensing set-up comprising multi-walled carbon nanotube/polyaniline nanotube nanocomposite as a detecting element for methanol vapor. Chapter 3 deals with the incorporation of high surface area mesoporous carbon black nanoparticles into an electrode comprising carbon black/polyaniline nanotube nanocomposite to act as a potential platinum-free low-cost counter electrode in dye sensitized solar cell. In chapter 4, highly porous and large surface area reduced graphene aerogels are functionalized with silver nanorods and polyaniline nanotubes to fabricate two different types of electrodes, one with electrochemical double layer capacitive behavior and the other pseudo-capacitive behavior, for an asymmetric supercapacitor with a wide working potential window. In chapter 5, carbon dots with tunable emission are prepared by hydro-/solvothermal route and the as-produced nanoparticles are used to harness visible light for catalysis of methanol oxidation reaction and oxidation of N719 dye in dye sensitized solar cell, as well as to detect picric acid in an organic medium by fluorescence quenching effect. Finally, chapter 6 presents the major findings of our work along with its future scope.

We hope that this thesis will contribute to the rapidly evolving field of carbon based nanomaterials and open up the new possibilities of further research on this topic.

This research was carried out in the Department of Chemical Sciences, Tezpur University, Assam, India.

Anindita Bora