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CERTIFICATE

It is certified that the work contained in the thesis entitled, **"Studies on Polyaniline based Composites for Biosensors"** by **Ms. Vineeta Gautam** has been carried out under my supervision and this work has not been submitted elsewhere for a degree.

It is further certified that the student has fulfilled all the requirements of Comprehensive, Candidacy and SOTA.

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DECLARATION BY THE CANDIDATE

I, **"Vineeta Gautam"**, certify that the work embodied in this thesis is my own bona fide work and carried out by me under the supervision of **"Dr. Vijay Laxmi Yadav"** from "September 2012 to January 2018" at the Department of Chemical Engineering & Technology, Indian Institute of Technology, Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that I have not willfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports dissertations, theses, etc., or available at websites and have not included them in this thesis and have not cited as my own work.

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Preface

The multicomponent advanced material having specific nanostructure is a current trend of nanotechnological research. Blending and composite formation are easy and innovative ways to produce novel nanomaterials. Varieties of material from different classes can be combined together at micro to nano level and give a hybrid system. Such hybrid/composite materials have some novel and synergic properties and such systems have been extensively used in industrial, technological, scientific and domestic applications. Nanocomposites display properties that are superior to those of either of the pure component phases and even to those of the conventional composites. Recent advances in composite and nanocomposite material technology boosted the development of sensor/biosensors. Electro-analytical application of composite is a popular and interesting research area. PANI nanocomposite materials with the large surface area, high porosity, and high conductivity provide excellent performance to develop electrochemical sensor device.

This thesis deals with polyaniline based composite materials and their application for electrochemical sensor/ biosensors. This thesis consists nine chapters; first three chapters provide a brief introduction of the characteristics of polyaniline and extensive survey on polyaniline based material for electrochemical sensors. We also provide a short description on the instrumental techniques which used in this research work. The experimental portion of this thesis described polyaniline polysaccharide material systems. The ternary system is more complex than the binary system, attributed to multifold interaction among different constituents. Chapter 4 described the comparative analysis of PANI/Polysaccharide composite systems, using Starch, CMC, Cellulose acetate and Chitosan. Chapter 5 and 7

described a comparative study on the binary and tertiary material of polyaniline along with Starch and CMC. MWCNTs were used to improve the bulk conductive and surface area of the material. Chapter 6 described the application of PANI/MWCNTs/Starch for hydrogen peroxide and glucose sensing. In chapter 7, PANI/MWCNTs/CMC was extensively discussed and applied for ascorbic acid sensing. Chapter 8 described the formation rod-shaped nanostructure of polyaniline, prepared in lemon juice extract and compared with PANI-HCl, and PANI-Citric acid. PANI nanorods used to detect Catechol.

We have proposed a hypothetical concept "Multi-component Template Effects" under which we explain that different molecules in the natural extract could be used to manipulate the morphology of synthetic nanoparticles and polymers. To fabricate electrochemical sensors, carbon paste capillary electrode was used and the responses of different analytes were measured using cyclic voltammetry. Other electrochemical techniques were also used to explore electrode processes and evaluate the performance of the developed sensors. Polyaniline/polysaccharides are excellent electrode material and have potential to be used for the commercial production of low-cost sensor strips.

The part of the thesis has been published in Polymer composites (38, 2017), Polymer Science A (58, 2016), Sustainable Chemistry and Engineering (2017). The remaining part of the thesis is in press (Carbohydrate polymers, International journal of biological macromolecules, Material today nano).

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