

Dedicated to

My

Mother

Father

Wahed

&

Wali

Declaration

I declare that the thesis entitled, "*Surface Enhanced Raman Spectroscopic Study of some Functional Molecules Adsorbed on Noble Metal Nano Particles*", has been prepared by me under the joint supervision of Dr. Sripada Halder, Associate Professor and Head, Department of Physics, University of North Bengal, WB, India and Dr. Uttam K Sarkar, Associate Professor and Head, Department of Physics, Malda College, Malda, WB, India. No part of this thesis has formed the basis for the award of any degree or fellowship previously.

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CERTIFICATE

Certified that Mr. Washim Hossain has prepared the thesis entitled, "**Surface Enhanced Raman Spectroscopic Study of some Functional Molecules Adsorbed on Noble Metal Nano Particles**" for the award of the Ph.D degree of the University of North Bengal, under joint supervision of myself and Dr. Uttam K Sarkar, Associate Professor and Head, Department of Physics, Malda College, Malda, WB, India. The research work presented in the thesis has been carried out collaboratively in the Department of Physics, University of North Bengal and in the Department of Physics, Malda College, Malda.

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CERTIFICATE

This is to certify that **Mr. Washim Hossain** has prepared the thesis entitled, "**Surface Enhanced Raman Spectroscopic Study of some Functional Molecules Adsorbed on Noble Metal Nano Particles**", for the award of Ph.D degree of the University of North Bengal. Mr. Hossain carried out his pre-Ph.D research work as the UGC Project Fellow appointed in the UGC Major Research Project No. *F 41-834/2012(SR) Dated 18.07.2012* collaboratively in the Department of Physics, Malda College and the Department of Physics, University of North Bengal under the joint supervision of the undersigned and Dr. Sripada Halder, Associate Professor and Head, Department of Physics, University of North Bengal.

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Sources included in the report:

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Preface

The thesis entitled “*Surface Enhanced Raman Spectroscopic Study of some Functional Molecules Adsorbed on Noble Metal Nano Particles*” is the presentation of my pre-Ph.D research works that I carried out in the Department of Physics, Malda College, Malda and the Department of Physics, University of North Bengal. The entire research work has been described in nine different chapters. The first chapter covers a brief review on *Raman spectroscopy and Surface Enhanced Raman spectroscopy*. A concise description of the *Materials* used and the *Experimental Methods* adopted in the present work is given in the second chapter. Chapter 3 to 8 includes the experimental results obtained and their discussions. Finally, the work has been concluded in chapter 9.

While carrying out my entire research work, I have been enriched with first-hand experience in using different high-tech equipments and necessary softwares required for the purpose. Throughout my research work, I have consulted many books, research papers, documents and references (online and print) with a view to acquire deep understanding on the topic.

I would like to thank the **Almighty God** for his abundant grace and blessings bestowed upon me to reach this milestone in my life. Without **Him**, I would have nothing else to be thankful for.

It is my pleasure to thank one of my supervisors Dr. Sripada Haldar, Head, Department of Physics, University of North Bengal for his guidance, constant support and encouragement throughout my entire research career.

My heartiest thanks go to my other supervisor Dr. Uttam Kumar Sarkar, Head, Department of Physics, Malda College, Malda whose supervision, enthusiasm and support always encouraged me and helped me to overcome any hurdle at any stage I have faced in my research and my personal life. I feel myself lucky enough to come and remain in touch with such a brilliant, experienced and versatile person who has not only helped me in shaping my entire work but also

enriched my knowledge with his affluent and unique ideas and experience in the field of Raman Spectroscopy.

I am grateful to all the respected faculty members and other staff of the Department of Physics, University of North Bengal, whose continuous motivation and support has helped me in doing the work at this Department successfully, especially Dr. Rajat Kumar Dey, NBU, who provided me with impetus and motivation during my masters and research periods.

I am sincerely thankful to all the faculty members of the Departments of Physics and Chemistry, Malda College, Malda, for their kind help and support. My appreciation is extended to Mr. Goutam Karmakar of the Department of Physics, Malda College for his co-operation and best wishes.

I am greatly indebted to my co-workers. I do express my sincere thanks to Prof. Chittaranjan Sinha, Jadavpur University for his generous support and encouragement to carry out the work. I have done all of my sample preparation work and recording of UV-visible spectra in his laboratory at the Department of Chemistry, Jadavpur University. I would like to extend my sincere thanks to Prof. Dilip Kumar Debnath of CBPBU, Coochbehar for his valuable suggestions. I would also like to thank Dr. Manas Ghosh for his patient co-operation while obtaining Raman Spectra in IACS, Kolkata. Thanks are due to Dr. Chandana Sen for her assistance and immense help throughout the tenure of the Ph.D work.

I wish to convey my sincere thanks to the University Grant commission, New Delhi, for providing me with fellowship and other financial assistance [through the Major Research Project Grant No. F41-834/2012(SR) dated 18.07.2012].

I would like to acknowledge my indebtedness to my mother, father for their unconditional love, caring guidance and support. Many many thanks go to Wahed, Wali, Ela and Kanu for their unfailing encouragement, support and love.

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