...Dedicated to Maa, Pita, Roma, Bunu & Atharvv

PREFACE

The research work presented in this thesis including the literature review, research objectives, experimental work, data analysis and interpretation, and preparation of this dissertation, one research manuscript, one review article, two book chapters along with four conference presentations are completed by Rashmi Chetry under the direct supervision of Dr. Pankaj Bharali in the Department of Chemical Sciences, Tezpur University.

The following publications and presentations are developed from the work presented in this thesis.

A portion of Chapter 1 was published as a review article and two book chapters:

1. **Chetry, R.**, Goswami, C., Borah, B.J. and Bharali, P. Morphology-and size-selective Pd-Based electrocatalyst for fuel cell reactions. In Sudarsanam, P., Yamauchi, Y., Bharali P., editors, Heterogeneous nanocatalysis for energy and environmental sustainability, volume 1, Chap 8, pp 233-257, ISBN: 9781394183517, Wiley, 2022.
2. **Chetry, R.**, Bhuyan, S. P., and Bharali P. Bimetallic nanoparticles & their applications for oxygen reduction reaction (ORR) and urea oxidation reaction (UOR). In Saikia, P., Sarmah J. K., Gogoi P. editors, *Bimetals: Formation, properties and applications,* Chap 3, pp 47-79, ISBN: 979-8-89113-496-6, Nova Science Publishers, 2024.
3. Patowary, S., **Chetry, R.**, Goswami, C., Chutia, B. and Bharali, P. Oxygen reduction reaction catalysed by supported nanoparticles: advancements and challenges. *ChemCatChem*, 14(7): e202101472, 2022.

A version of Chapter 3 is under preparation for publication:

1. **Chetry, R.,** Bhuyan, S. P., Dutta, R., Das, S., Das, M.R. and Bharali, P. Increasing ORR kinetics of Pd/C via Ag and Cu integration: A robust and promising catalyst for oxygen reduction reaction *(Submitted)*.

A version of Chapter 4 was published as a research article and presented in two conferences:

1. **Chetry, R.,** Chutia, B., Patowary, S., Borah, B.J., Sudarsanam, P., Bharali, P. Electronic modulation of Pd/C by simultaneous doping of Cu and Co

tendering a highly durable and methanol-tolerant oxygen reduction electrocatalyst. *Energy & Fuels*, 37(13): 9557–9567, 2023.

2. **Poster presentation,** Pd_2CoCu alloy supported on vulcan carbon as a highly efficient electrocatalyst for oxygen reduction reaction, "*International Conference on Emerging Trends in Chemistry (ICETC)" at Assam Donbosco University in collaboration with Department of Chemistry, Pandu College, Guwahati, 16-17th March, 2023*.
3. **Oral presentation,** Pd_2CoCu/C nanoparticles as a highly efficient electrocatalyst for oxygen reduction reaction, "*National Conference on Sustainability, Medicine and Clean Energy organized" at Tezpur University, Tezpur, 1st March, 2022.*

A version of Chapter 5 is submitted for publication and presented at a conference:

1. **Chetry, R.,** Dutta, R., Das, M.R. and Bharali, P. Deciphering the effect of Fe and Cu in Pd lattice for oxygen reduction reaction *(Under revision)*.
2. **Poster presentation,** Deciphering the effect of Fe and Cu in Pd/C lattice for oxygen reduction reaction, "*Sustainable Chemistry & Engineering (SusChemE-2023)*" *at Institute of Chemical Technology, Mumbai, 14-16th September, 2023*.
3. **Poster presentation,** Deciphering the effect of Fe and Cu in Pd/C lattice for oxygen reduction reaction, "*RSC Poster: A global online poster conference (RSC Poster-2024)*", *5-6th March, 2024*.

A version of Chapter 6 is under preparation for publication:

1. **Chetry, R.,** and Bharali, P. Engineering ultralow Pd-content on CuO_X/C for efficient oxygen reduction electrocatalysis (*to be submitted)*.

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DECLARATION

This thesis entitled *"**Design of Pd-based Electrocatalysts for Oxygen Reduction Reaction**"* being submitted to the Department of Chemical Sciences, Tezpur University, is a presentation of the original research work carried out by me. Any contribution (texts, figures, results or designs) of others, wherever involved, is appropriately referenced in order to give credit to the original author(s). All sources of assistance have been duly acknowledged. I affirm that neither this work as a whole nor a part of it has been submitted to any other university or institute for any other degree, diploma or award.

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CERTIFICATE FROM THE SUPERVISOR

This is to certify that the thesis entitled "**Design of Pd-based Electrocatalysts for Oxygen Reduction Reaction**" submitted to the School of Sciences, Tezpur University in part fulfillment for the award of the degree of Doctor of Philosophy in Chemical Sciences is a record of research work carried out by **Ms. Rashmi Chetry** under my supervision and guidance. All help received by her from various sources have been duly acknowledged. No part of this thesis has been submitted elsewhere for award of any other degree.

Dr. Pankaj Bharali
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Place: Tezpur University — Rashmi Chetry

Date: 12-12-2024 — (ৰশ্মি ছেত্ৰী)

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