

**SCHOOL OF MATERIALS SCIENCE AND TECHNOLOGY  
INDIAN INSTITUTE OF TECHNOLOGY  
(BANARAS HINDU UNIVERSITY)  
VARANASI - 221005**



---

## **CERTIFICATE**

It is certified that the work contained in the thesis titled “**Studies on superparamagnetic silver coated magnetite core shell nanostructures for multimodal applications**” by **Ms. Pinki Singh** has been carried out under our supervision and that this work has not been submitted elsewhere for a degree.

It is further certified that the student has fulfilled all the requirements of Comprehensive Examination, Candidacy and SOTA for the award of Ph.D. Degree.

**Dr. Chandan Upadhyay**

**(Supervisor)**

**School of Materials Science & Technology**

**Indian Institute of Technology**

**(Banaras Hindu University)**

## CERTIFICATE

This is to certify that the revised thesis entitled "Studies on superparamagnetic silver coated magnetic core shell nanostructures for multimodal applications" is being submitted by Ms. Pinki Singh in partial fulfillment for the award of Ph.D. in School of Materials Science and Technology, IIT (BHU), Varanasi is a record of bonafide work carried out by her.

Date of Submission:

(Supervisor)

Forwarded by:

HoD/CoS  
(Signature with Seal)

## **DECLARATION BY THE CANDIDATE**

I, “Pinki Singh”, certify that the work embodied in this thesis is my own bonafide work and carried out by me under the supervision of “Dr. Chandan Upadhyay” from July 2013 to Jan 2019, at the School of Materials Science& Technology, Indian Institute of Technology (Banaras Hindu University), 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 others work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports dissertations, thesis, etc., or available at websites and have not included them in this thesis and have not cited as my own work.

Date of Submission: 17<sup>th</sup> Jan, 2019

Date of Resubmission:

Place: Varanasi

(Ms. Pinki Singh)

## **CERTIFICATE BY THE SUPERVISOR**

It is certified that the above statement made by the student is correct to the best of my knowledge.

**Dr. Chandan Upadhyay**  
**(Supervisor)**  
**School of Materials Science& Technology**  
**Indian Institute of Technology**  
**(Banaras Hindu University)**  
**Varanasi**

**Dr. Chandana Rath**  
**(Coordinator)**  
**School of Materials Science& Technology**  
**Indian Institute of Technology**  
**(Banaras Hindu University)**  
**Varanasi**

# **COPYRIGHT TRANSFER CERTIFICATE**

**Title of the Thesis: STUDIES ON SUPERPARAMAGNETIC SILVER COATED  
MAGNETITE CORE SHELL NANOSTRUCTURES FOR  
MULTIMODAL APPLICATIONS**

**.Name of the Student:** Ms. Pinki Singh

## **Copyright Transfer**

The undersigned hereby assigns to the Indian Institute of Technology (Banaras Hindu University) Varanasi all rights under copyright that may exist in and for the above thesis submitted for the award of the “Doctor of Philosophy” degree.

Date of Submission: 17<sup>th</sup> Jan, 2019

Date of Resubmission:

**Place:** Varanasi

(Ms. Pinki Singh)

**Note:** However, the author may reproduce or authorize others to reproduce material extracted verbatim from the thesis or derivative of the thesis for author's personal use provided that the source and the Institute's copyright notice are indicated.

## **Acknowledgements**

**“Neither by paying money nor by paying thanks one can  
unencumbered to parents and teachers”**

*At this moment of retrospection, it gives me immense pleasure to acknowledge the persons who have me directly or indirectly during the course of my work and stay in IIT (BHU) To express my heartfelt gratitude is not only my moral duty but I consider it an act of pleasure and humility as well.*

*I wish to express my deep sense of appreciation and everlasting indebtedness to Dr. Chandan Upadhyay, School of Materials Science & Technology, Indian Institute of Technology (Banaras Hindu University), for being a father away from home. I do not have enough words to describe my gratitude towards him for teaching me how to not only be a better researcher and but also a better person. I earnestly owe him for what I am today and what I will be in days to come.*

*I would like to thanks Dr. A.K. Singh (Coordinator), School of Materials Science & Technology, Institute of Technology (Banaras Hindu University) and Prof. Rajiv Prakash and Prof. Pralay Maity, Ex-coordinator of the School for encouraging me and providing me all the facilities to carry out my research work.*

*I would also like to express my sincere thanks to RPEC member's Prof. Rajiv Prakash, School of Materials Science & Technology, IIT (BHU) and Dr. Shiru Sharma, School of Biomedical Sciences, IIT (BHU), for their stimulating help and criticism which incented me to widen my research from various*

*perspectives. I would like to express my sincere gratitude to Dr. B.N. Pal (DPGC convener) for his valuable inputs, suggestions and affectionate attitude.*

*I wish to express deep regards to all the teachers of the Department Prof. D. Pandey, Dr. C. Rath, Dr. A. K. Mishra, Dr. S. K. Mishra, Dr. Ashish Singh, Dr. S. R. Singh, Prof. Jitendra Kumar and other for their kind support at all moment during the progress of my research.*

*With a deep sense of gratitude I express my sincere thanks to CIFC, IIT (BHU), Varanasi for help in carrying characterization of the synthesized samples. I also extend my thanks to Mr. Vinay Bhardwaj for helping me in characterization of samples. I am also grateful to all office staff of the school and authorities of IIT (BHU), for their kind help during the period of my stay to complete the thesis work.*

*With a special thanks to my senior Mr. Pappu Kumar Harijan and labmates Mr Pramod Kumar Yadav, Ms. Manjari Shukla and Mr. Abhishek Tripathi for their suggestion and healthy discussion of my research issues. I am extremely thankful to my friends Ms. B. Bharti, Ms. Priyanka Tiwari, Ms. Vani Pawar and Mr. Upendra Kumar for their support, co-operation and sincere help in many ways as well as for making my stay here enjoyable and for their time to time encouragement during my bad situations.*

*My forever interested, encouraging and always enthusiastic my mother Mrs. Tetra Devi, my father Mr. Lalit Singh, my uncle Mr. Shyam Bihari Singh, my aunt Mrs. Kanti Singh, my father-in-law Mr. Shambhoo Nath and my mother-in-law Somwari Devi: they were always keen to know what I was doing and how I was proceeding, although it is likely that they have never grasped what it was all about! I love your screams of joy whenever a significant momentous was reached and also just your general impudence. I*

*am grateful to my husband Mr. Ram Singh Yadav, brother-in-law Shyam Singh Yadav and cousin brother Shreyash Raj, who have provided me through moral and emotional support in my life. I am also grateful to my best friend Ms. Sonam Perween, who has supported me along the way.*

*Finally, I bow with reverence and gratitude to thank the Almighty who has enriched me with such an excellent opportunity and infused the power in my mind to fulfil the work assigned to me.*

**Date of Submission: 17<sup>th</sup> Jan, 2019**

**Date of Resubmission:**

**Place: Varanasi**

**(Pinki Singh)**