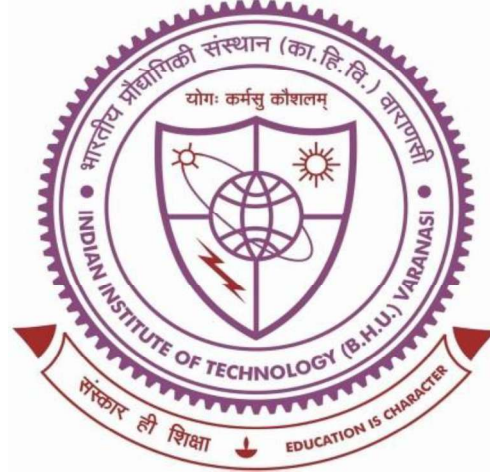


**Microstructure Evolution and Mechanical Property
Variation in Fe-Mn-Al-C Low-Density Steel during
Multiaxial Forging: Experimental and Numerical
Investigations**



**Thesis submitted in partial fulfillment for the
award of degree**

of

Doctor of Philosophy

by

Hemant Kumar

**Department of Mechanical Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi-221005**

Roll No. 18131002

2024

CERTIFICATE

It is certified that the work contained in the thesis titled **“Microstructure Evolution and Mechanical Property Variation in Fe-Mn-Al-C Low-Density Steel during Multiaxial Forging: Experimental and Numerical Investigations”** has been carried out under our supervisions 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 Examination, Candidacy and SOTA for the award of Ph.D. Degree.



Supervisor

Dr. Debashish Khan

Department of Mechanical Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi – 221005, INDIA.
Associate Professor
Deptt. of Mechanical Engg
Indian Institute of Technology (BH)
Varanasi-221005



Co-Supervisor

Dr. Rampada Manna

Department of Metallurgical Engineering
Indian Institute of Technology
(Banaras Hindu University),
Varanasi – 221005, INDIA.
Associate Professor
Department of Metallurgical Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi - 221005

DECLARATION BY THE CANDIDATE

I, "**Hemant Kumar**", certify that the work embodied in this thesis is my own bona fide work and carried out by me under the supervisions of "**Dr. Debashis Khan and Dr. Rampada Manna**", from **July 2018 to September 2024**, at the "**DEPARTMENT OF MECHANICAL ENGINEERING**", Indian Institute of Technology (BHU), 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 wilfully 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.

Date: 04/10/2024

Place: IIT (BHU), Varanasi


(HEMANT KUMAR)

CERTIFICATE FROM THE SUPERVISORS

This is to certify that the above statement made by the candidate is correct to the best of our knowledge.

Supervisor



Dr. Debashis Khan

Department of Mechanical Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi – 221005, INDIA
Associate Professor
Deptt. of Mechanical Engg
Indian Institute of Technology (BHU)
Varanasi-221005

Co-Supervisor



Dr. Rampada Manna

Department of Mechanical Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi – 221005, INDIA
Associate Professor
Department of Metallurgical Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi - 221005



Professor and Head

Department of Mechanical Engineering
Indian Institute of Technology
(Banaras Hindu University)
Varanasi – 221005, INDIA
विभागाध्यक्ष / HEAD

अध्यक्ष/अभियन्तृकी विभाग/Deptt. of Mechanical Engg.
भारतीय प्रौद्योगिकी संस्थान/Indian Institute of Technology
(काठहंडी/ B.H.U.)
वाराणसी-221005/Varanasi-221005

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The world was going through some unprecedented times as the normal had been upended by the arrival of the deadly coronavirus pandemic. People across the globe were battling with Covid-19. Many people who were locked at home like us were doing their part by helping others in various ways. But others like doctors, soldiers, teachers, bank employees, office staff, railway employees, social volunteers etc. were working outside to fulfil our requirements and taking care of the affected ones by risking their own lives. I would like to thank them for their service towards humanity. Also, I would like to express my deepest condolences to those who have lost their lives during this pandemic. Hope can always help to pull people out of the most difficult times. It is a powerful force and can prove to be a source of reassurance. Hence, I am immensely optimistic that very soon we will win this battle.

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(HEMANT KUMAR)