

Rama Srinivas VARANASI

Assistant Professor | Materials Science and Metallurgical Engineering, IIT Hyderabad

8 April, 1995

[in](https://www.linkedin.com/in/rama-srinivas-v) [linkedin.com/in/rama-srinivas-v](https://www.linkedin.com/in/rama-srinivas-v) [Google Scholar](https://scholar.google.com/citations?user=...)

☎ 070-116-09191 ✉ rama.varanasi@tohoku.ac.jp

📍 1-1-58, Itsutsubashi, Aoba-ku, Sendai-shi, Miyagi 980-0022, Room 409, Dia Palace Sendai Chuo



RESEARCH INTERESTS

Electron Channelling Contrast Imaging (ECCI), Hydrogen embrittlement, Metal hydrides, Steel, Phase transformations, Si-based anode materials for Li-ion batteries, Nitrided steels, Atom Probe Tomography (APT)

EDUCATION

- Oct 17- Feb 21 **Ruhr-Universität Bochum & Max-Planck-Institut für Eisenforschung**
PhD in the department of Mechanical Engineering, Ruhr-Universität Bochum (magna cum laude)
- Jul 12- Jul 17 **Indian Institute of Technology Madras**
Dual Degree (B.Tech and M.Tech) in Metallurgical and Materials Engineering, CGPA : 8.62/10
- May 10- Apr 12 **Mahathi Junior College, Visakhapatnam**
Board of Intermediate Education, Hyderabad, 94.8%
- Apr 10 **Delhi Public School, Visakhapatnam**
Central Board of Secondary Education, CGPA : 10/10

RESEARCH EXPERIENCE

JSPS Postdoctoral Research Fellow Apr 2024 - Mar 2026

Institute for Materials Research, Tohoku University; Guest Researcher at National Institute for Materials Science

- Mitigating intergranular hydrogen embrittlement via grain boundary segregation engineering in steels and Ni alloys
- Unraveling misorientation and segregation-dependent H diffusion at grain boundaries of polycrystalline Ni alloys
- Mechanisms of H-assisted damage evolution in boron-containing austenitic and duplex steels

Assistant Professor (Research)

Apr 2023 - Mar 2024

Environmentally Robust Materials Lab, Institute for Materials Research, Tohoku University

- Mentoring a master's student (constant load test of dual-phase steels) and a Ph.D. student (damage evolution in high-N steel)
- Microstructure design of martensitic steels to mitigate hydrogen-assisted fatigue crack growth (in 90 MPa gaseous H_2)
- Statistical understanding of crack growth paths within the Fe_4N compound layer during monotonic and cyclic tensile testing
- Clarifying damage evolution in high-nitrogen steel through 3-D image reconstruction of serial sectioning in a plasma-FIB

Postdoctoral researcher

Nov 2021* - Mar 2023

Advisor : Prof. Motomichi Koyama, Environmentally Robust Materials Lab, Institute for Materials Research, Tohoku University

- Study of the multi-stage brittle fracture via {100} ferrite cleavage cracking in a martensite-rich 1.5 GPa dual-phase (DP) steel
- H-induced delayed fracture susceptibility of a 1.5 GPa class dual-phase steel evaluated by U-bend test
- Fundamental mechanisms of H-assisted crack initiation and propagation in a 1.5 GPa class DP steel
- Phase transformations and microstructure evolutions during de-/hydrogenation in Fe-Mn-Si-Cr alloy and Fe-Mo alloys
- Development of novel Fe-based high-temperature intermetallic composite microstructures with enhanced toughness

*The planned start in April 2021 was delayed due to COVID-related visa issues.

Doctoral student

Oct 2017 - Mar 2021

Advisor : Prof. Dierk Raabe, Microstructure Physics and Alloy Design, Max-Planck-Institut für Eisenforschung

- Mechanism of austenite nucleation in medium Mn steels : Segregation-driven massive transformation at ferrite grain boundaries
- Austenite growth in medium Mn steels : Critical role of 'short circuit' diffusion paths provided by crystalline defects
- NbC precipitation at dislocations in a Nb microalloyed medium Mn steel and its influence on defect-driven austenite reversion
- Multiscale in-situ investigations to unravel yielding mechanisms in ultrafine-grained medium Mn steels
- Magnetic annealing of a medium Mn steel : Influence of magnetic field on Mn grain boundary segregation
- Machine learning methods for atom probe tomography (APT) & H-charging of lifted-out specimen for APT (as a collaborator)

Master's thesis (DAAD IIT Master Sandwich scholar)

Aug 2016 - May 2017

Advisor : Dr. K G Pradeep, Materials Chemistry, RWTH Aachen University & Prof. B S Murty, IIT Madras

- Synthesis of nanostructured SiTiNi (STN) thin film anode materials by DC-Magnetron Sputtering and subsequent annealing
- Elucidating the phase formation mechanisms using transmission electron microscopy and atom probe tomography
- Understanding the mechanism of Li intercalation during lithiation

 Google Scholar- Citations : 522, h-index : 10;  Scopus Author Identifier- 57202981163;  ORCID id- 0000-0003-3837-6129

Journal	Quartile	Impact factor	First-authored papers	Co-authored papers	Total
Acta Materialia	Q1	9.4	2	1	3
Materials Research Letters	Q1	8.6	-	1	1
Corrosion Science	Q1	8.3	-	1	1
International Journal of Hydrogen Energy	Q1	7.2	2	-	2
Patterns	Q1	6.5	-	1	1
Materials Science and Engineering : A	Q1	6.4	2	1	3
Scripta Materialia	Q1	6	1	-	1
Materials Characterization	Q1	4.8	1	1	2
Journal of Materials Science	Q1	4.0	1	-	1
Metallurgical and Materials Transactions A	Q1	2.8	1	-	1
Ultramicroscopy	Q1	2.2	-	1	1
ISIJ International	Q2	2	-	4	4
Open Research Europe	Q2	N/A	-	1	1
Total			10	12	22

Surface and internal crack growth during tensile loading in Ni-free high-nitrogen austenitic steel; M Koyama, Y Wang, [RS Varanasi](#), T Masumura, T Tsuchiyama. *ISIJ International* (2026)

Revealing Strength-Ductility Synergy in TRIP-Assisted Lean Duplex Stainless Steels : The Critical Role of Strain-induced Martensitic Transformation Kinetics in Damage Tolerance and Fracture Mechanism; Y Wang, X Cai, [RS Varanasi](#), Z Wang, M Jin, H Huang, X Ma, L Chen, M Koyama. *Materials Science and Engineering : A*, 945, 149039 (2025)

Temperature and misorientation-dependent austenite nucleation at ferrite grain boundaries in a medium manganese steel : role of misorientation-dependent grain boundary segregation; [RS Varanasi](#), O Waseda, FW Syed, P Thoulden-Sukumar, B Gault, J Neugebauer, D Ponge. *Acta Materialia*, 296, 121242 (2025)

Semi-quantitative characterisation of coherency-dependent hydrogen diffusion at $\Sigma 3$ grain boundaries in pure Ni; H Kakinuma, M Koyama, [RS Varanasi](#), S Ajito, E Akiyama. *Materials Research Letters*, 13, 357–364. (2025)

Novel Fe-Mo intermetallic composite synthesized via novel diffusional-displacive mixed-mode transformation; [RS Varanasi](#), M Koyama, S Kiranbabu, R Schnitzer, H Saitoh, R Utsumi, E Akiyama. *Materials Characterization*, 114287 (2024)

Understanding crack growth propagation within the γ' Fe_4N layer in a nitrided low carbon steel during monotonic and cyclic tensile testing; [RS Varanasi](#), M Koyama, M Yokoi, Y Ootani, M Kubo, K Tanahara, O Umezawa. *Journal of Materials Science* 59, 14639–14652 (2024)

Critical role of initial multi-phase microstructure on the phase transformations during hydrogenation in Fe-Mo alloy system; [RS Varanasi](#), M Koyama, H Saitoh, R Utsumi, T Sato, S Orimo, E Akiyama. *International Journal of Hydrogen Energy* 50, 1418–1434 (2024)

Hydrogen Embrittlement Property of a 1.5 GPa Dual-Phase Steel Evaluated Using U-Bending Test : A Comparison with Tempered Martensitic Steel with Identical Tensile Strength; S Chiba, M Koyama, Y Shibayama, S Ajito, T Hojo, [RS Varanasi](#), E Akiyama. *ISIJ International* 64, 706–713 (2024)

Overview of Hydrogen effects on γ - ϵ martensitic transformation in steels; M Koyama, S Iikubo, [RS Varanasi](#). *ISIJ International* 64, 732–741 (2024)

Hydrogen-Induced Delayed Fracture in a 1.5 GPa Dual-Phase Steel Via Coalescence of Surface and Sub-Surface Cracks; [RS Varanasi](#), M Koyama, Y Shibayama, S Chiba, S Ajito, T Hojo, E Akiyama. *Metallurgical and Materials Transactions A* 54, 2989–2997 (2023)

Phase transformations and microstructure evolutions during depressurization of hydrogenated Fe–Mn–Si–Cr alloy; [RS Varanasi](#), M Koyama, H Saitoh, R Utsumi, T Sato, S Orimo, E Akiyama. *International Journal of Hydrogen Energy* 48, 10081–10088 (2023)

Mixed Type Brittle Fracture in 1.5 GPa Dual-Phase Steel Via $\{100\}$ Ferrite Cleavage Cracking; [RS Varanasi](#), M Koyama, Y Shibayama, E Akiyama. *Materials Science and Engineering : A* 857 (2022)

Hierarchical Deformation Heterogeneity during Lüders Band Propagation in an Fe-5Mn-0.1C Medium Mn Steel Clarified through in situ Scanning Electron Microscopy; M Koyama, T Yamashita, S Morooka, Z Yang, [RS Varanasi](#), T Hojo, T Kawasaki, S Harjo. *ISIJ International* 62, 2043–2053 (2022)

Hydrogen and deuterium charging of site-specific specimen for atom probe tomography; H Khanchandani, S Kim, [RS Varanasi](#), TS Prihiv, L T. Stephenson, B Gault. *Open Research Europe* 1:122 (2022)

Effect of Nb micro-alloying on austenite nucleation and growth in a medium manganese steel during intercritical annealing; [RS Varanasi](#), B. Gault, D Ponge. *Acta Materialia* 229 (2022)

Mechanisms of austenite growth during intercritical annealing in medium manganese steels; [RS Varanasi](#), M Lipińska-Chwałek, J Mayer, B Gault, D Ponge. *Scripta Materialia* 206 (2022)

Localized deformation inside the Lüders front of a medium manganese steel; [RS Varanasi](#), S Zaefferer, B Sun, D Ponge. *Materials Science and Engineering : A* 824 (2021)

Trivalent Chromium coated steels : Characterization and Cathodic delamination behavior; JM Prabhakar, [RS Varanasi](#), CC da Silva, Saba, ACA de Vooy, B Gault, A Erbe, M Rohwerder. *Corrosion Science* 187 (2021)

Machine-Learning-Enhanced Time-of-Flight Mass Spectrometry Analysis; Y Wei, [RS Varanasi](#), T Schwarz, L Gomell, H Zhao, D J Larson, B Sun, G Liu H Chen, D Raabe, B Gault. *Patterns* 2 (2021)

Macroscopic to nanoscopic in situ investigation on yielding mechanisms in ultrafine grained medium Mn steels : Role of the austenite-ferrite interface; B Sun, Y Ma, N Vanderesse, [RS Varanasi](#), W Song, P Bocher, D Ponge, D Raabe. *Acta Materialia* 178, 10-25 (2019)

Machine-learning-based atom probe crystallographic analysis; Y Wei, B Gault, [RS Varanasi](#), D Raabe, M Herbig, AJ Breen. *Ultramicroscopy* 194, 15-24 (2018)

Evolution of morphology and texture during high energy ball milling of Ni and Ni-5 wt% Cu powders; N Chawake , [RS Varanasi](#), B Jaswanth, L Pinto, S Kashyap, NTBN Koundinya, AK Srivastav, A Jain, M Sundararaman, and RS Kottada. *Materials Characterization* 120, 90-96 (2016)

Hydrogen-induced fast fracture in a 1.5 GPa dual-phase steel; [RS Varanasi](#), M Koyama, S Chiba, S Ajito, E Akiyama. (In preparation)

Understanding the effect of grain orientation on nanoindentation behavior in Fe_4N : absence of anisotropy in indentation elastic modulus and hardness; [RS Varanasi](#), Y Zhang, G Miyamoto, M Koyama. (In preparation)

Effect of external magnetic field on Mn segregation at ferrite grain boundaries; FW Syed, [RS Varanasi](#), L Han, B Gault, D Ponge, D Raabe. (In preparation)

SCHOLASTIC ACHIEVEMENTS

- 2024 ICC-IMR Young Fellowship; Travel grant of ₹0.25 million for an overseas Visit
- 2023 JSPS postdoctoral fellowship for 2 yrs; Research grant of ₹2.1 million
- 2022 Sawamura Award - ISIJ international best paper award (awarded to 6 out of ~350 papers published in 2022)
- 2017 Bhagyalakshmi & Krishna Ayengar award - Best thesis in the field of alternative energy
- 2016 Awarded DAAD IIT Master Sandwich Scholarship
- 2015 Offered DAAD WISE(Working Internships in Science and Engineering) Scholarship
- 2012 Kishore Vaigyanik Protsahan Yojana (KVPY) fellowship, Govt. of India
- 2012 Ranked 338 (out of 1.3 million applicants), All India Engineering Entrance Examination

TECHNICAL SKILLS

Focused Ion Beam Microscopes and Scanning Electron Microscopes

- FEI® Helios Nanolab™ 600/ 600i/ Xe-plasma FIB-SEM DualBeam™ microscope for APT & TEM sample preparation
- Transmission Kikuchi Diffraction (TKD) of APT/TEM sample
- Lift-out approach for site-specific 3-D EBSD
- Zeiss Merlin and Zeiss Gemini 1540XB for Electron Channel Contrast Imaging under controlled diffraction conditions (cECCI)
- JEOL JSM-6500F SEM with an EDAX Digiview IV EBSD detector for Electron Backscatter Diffraction (EBSD)

Software packages

- Thermo-calc for thermodynamic calculations
- AP suite 6.0 & IVAS for APT data reconstruction
- ARAMIS & VIC-2D for digital image correlation (DIC)
- OIM & DREAM.3D/ParaView for 2-D/3-D EBSD data analysis
- Avizo/Amira for 3-D image reconstruction

Atom Probe Microscopy

- CAMECA® LEAP™ 4000X HR, LEAP™ 5000 XS/XR
- Ferrovac® cryo ultra-high vacuum carry transfer suitcase
- Reactor hub module for the heat treatment of APT samples in controlled atmosphere

Others

- Thermal desorption spectroscopy (TDS)
- Tensile testing coupled with digital image correlation (DIC)
- Bruker AXS D8 GADDS for XRD measurements
- DC magnetron sputtering
- In-situ SEM tensile testing coupled with ECCI
- Transmission electron microscopy (basic)
- Fritsch Pulverisette-5 Mill for high energy ball milling
- TESCAN AMBER X - Plasma FIB
- Hysitron TI950 TriboIndenter

ORAL PRESENTATIONS

- > *Understanding the critical role of microstructure in enhanced resistance to H-assisted fatigue crack growth in ausformed and tempered martensitic steels*; TMS Annual Meeting 2025; [RS Varanasi](#), M Koyama, T Redarce, K Kobayashi, H Kakinuma, A Shibata, H Matsunaga, E Akiyama
- > *Diffusional-displacive mixed-mode transformation from ferrite parent phase to form an intermetallic nanocomposite in a Fe-Mo alloy*; TMS Annual Meeting 2025; [RS Varanasi](#), S Kiranbabu, R Utsumi, H Saitoh, R Schnitzer, E Akiyama, M Koyama
- > *Microstructural origins of enhanced resistance to h-assisted fatigue crack growth in ausformed and tempered martensitic steels*; European Conference on Fracture, 2024; [RS Varanasi](#), M Koyama, T Redarce, K Kobayashi, H Kakinuma, A Shibata, H Matsunaga, E Akiyama
- > *Hydrogen Embrittlement behavior of a 1.5 GPa class dual phase steel*; International Conference on Fracture, 2023; [RS Varanasi](#), M Koyama, Y Shibayama, S Chiba, E Akiyama
- > *Delayed fracture susceptibility of a 1.5 GPa class dual phase steel evaluated by U-bend test*; European Conference on Fracture, 2022; [RS Varanasi](#), M Koyama, Y Shibayama, S Chiba, S Ajito, T Hojo, E Akiyama
- > *Microstructural Origins of Lüders Banding in Medium Mn Steels*; TMS Annual Meeting 2020; [RS Varanasi](#), D Ponge, D Raabe
- > *Influence of Nb microalloying on austenite reversion in Medium Mn steels*; Euromat 2019; [RS Varanasi](#), D Ponge, D Raabe
- > *The effect of Nb microalloying in Medium Mn steels*; 2019, 4th International Conference on Medium and High Manganese Steel - HMnS 2019; [RS Varanasi](#), D Ponge, D Raabe

REVIEWING ACTIVITIES

Acta Materialia, International Journal of Hydrogen Energy, Materials Science and Engineering : A, Materials Characterization, npj Materials Degradation, Scripta Materialia, Steel Research International

MENTORING EXPERIENCE

- > PhD student at Max Planck Institute for Sustainable Materials on the '*Effect of external magnetic field on Mn segregation at ferrite grain boundaries*'; [2021-2024](#)
- > Exchange PhD student at the Institute for Materials Research, Tohoku University on '*Understanding the damage evolution in a high-nitrogen steel using Electron channeling contrast imaging (ECCI)*'; [2023-2024](#)
- > Master's student at the Institute for Materials Research, Tohoku University on '*Hydrogen-induced delayed fracture in a 1.5 GPa Dual-Phase Steel using constant load tests*'; [2022-2024](#)

LEADERSHIP EXPERIENCE

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| 2019-20 | Member, PhDnet survey group
Responsible for running a survey, catering to 5,000 doctoral researchers working at 86 Max Planck institutes PhDnet Report 2019 ; Olsthoorn LH, Heckmann L, Filippi A, Vieira RM, Varanasi RS et al. |
| 2017 -18 | PhD student representative, MPIE Student representative of ~ 100 doctoral students from 25+ countries
Organized career talks, MPIE lecture series, soft skill courses, annual IMPRS symposium, and industry visits |
| 2014 -16 | Head, Editorial Board, Etch, Dept. Magazine
Led a 14-member team that published articles promoting metallurgy and materials science |
| 2015-16 | Strategist, Career Development Team, IIT Madras
Facilitated student-alumni interactions & supported the functioning of Analytics/Finance/Consulting clubs |
| 2015 | Head, Workshops & Demonstrations, Amalgam, MME Dept. Technical Festival
Managed 7 workshops, with a 100 % increase in registrations (accounting for 25% of the revenue) |

INDUSTRIAL INTERNSHIP EXPERIENCE

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| Dec 2014 | Intern, Titan Company Limited (Watch division), Hosur, India |
| Jan 2015 | > Improving tool life through changes in tool material and heat treatment cycle of tool and back cover |
| Jun 2014 | Industrial training at Visakhapatnam Steel Plant , Visakhapatnam, India |
| Jul 2014 | > Gained insights in operation & functioning of mills, blast furnace, and steel melting shop |