MAYUR VAIDYA

Assistant Professor
Indian Institute of Technology Hyderabad, Kandi, Telangana - 502285
Mobile: +91-7879916780 Email: vaidyam@msme.iith.ac.in

PROFILE:

- Highly motivated researcher with demonstrated research expertise in measuring diffusion properties of materials and processing of bulk and nanocrystalline alloys.
- Experimental techniques: Radiotracer diffusion, interdiffusion, secondary ion mass spectrometry, mechanical alloying, spark plasma sintering, vacuum arc melting, high pressure torsion, X-ray diffraction, scanning electron microscopy, electron back-scattered diffraction.

EDUCATION:

Indian Institute of Technology Madras
PhD in Metallurgical & Materials Engineering (CGPA – 9.75/10)
(Aug 2012- Dec 2017)
Thesis title: Thermal stability and diffusion behaviour of CoCrFeNi and CoCrFeMnNi equiatomic high entropy alloys

B.Tech + M.Tech (Dual degree program) in Metallurgical & Materials Engineering (CGPA – 8.94/10)
(Aug 2005 - July 2010)

RESEARCH INTERESTS:

- Diffusion-deformation correlation in materials
- Phase growth and interdiffusion kinetics in thermoelectric materials
- Diffusion in multicomponent alloys
- Processing, characterization and stability of nanocrystalline alloys

RESEARCH EXPERIENCE:

- **University of Münster, Münster, Germany**

Post-doctoral candidate (May 2018 – Dec 2019).
Host – PD Dr. Sergiy Divinski, Institute of Materials Physics

The current role requires supervising multiple projects on various aspects of diffusion in materials. In addition to carrying out own research work, it is my responsibility to train students (currently 3 PhD and 1 Masters) in experimental techniques and analysis of diffusion measurements.

a. Effect of deformation on diffusion in Ni and Ni-Cr alloys

Grain boundary (GB) diffusion of Cr in Ni and Ni-Cr alloys is being measured as a function of deformation. The determined diffusion coefficients serve as valuable input to model diffusion-controlled phenomenon (such as oxidation) in these alloys in service conditions. Radiotracer method as well as secondary ion mass spectrometry (SIMS) is used to investigate statistical and local diffusion behaviour, respectively. Pioneering measurements of strain induced deformation of Cr diffusion in Ni are also being carried out.

b. Self- and solute diffusion in HCP alloys

Using radiotracer analysis, diffusion of Ti (self) and Co (solute) is being investigated in series of HCP alloys viz. HfZr, HfTiZr, $Al_5Sc_{20}Hf_{25}Ti_{25}Zr_{25}$ and $Al_{15}Sc_{10}Hf_{25}Ti_{25}Zr_{25}$ (Al15). Preliminary results show that the phenomenon of ultra-fast solute diffusion is observed in all the alloys, concomitant with that reported in literature for pure Ti. Ab-initio calculations have shown the presence of ordered phase in Al15 alloy below 850 ºC and has been verified with experiments. Self and solute diffusion measurements will be carried out as a function of order parameter to determine its influence on atomic transport in this alloy.

c. Diffusion in complex phases

Ni sub-lattice in binary AlNi is substituted with Co, Fe and Ti to form ternary, quaternary and quinary multicomponent alloys with B2 structure. The influence of increasing disorder on Ni sublattice on diffusion kinetics is proposed to be measured using radiotracer analysis. σ phase formation has been frequently observed in HEAs, which influences their deformation characteristics. Tracer diffusion measurements of Cr and Ni in Cr-rich multicomponent σ phase are being carried out to probe their diffusion kinetics.

d. Influence of carbon on diffusion kinetics in HEAs

The project aims to investigate the role of carbon on interdiffusion of constituent elements in CoCrFeNi and CoCrFeMnNi HEAs. Meticulous experiments using diffusion couple of non-carbon containing HEAs and carbon containing HEAs are being carried out to obtain the concentration profiles in presence and absence of C. Radiotracer experiments are also being proposed to examine the systematic influence of carbon concentration on self-diffusion behaviour in these alloys.

e. Microstructural evolution during high pressure torsion (HPT) of alloys

FCC and HCP multicomponent alloys are subjected to HPT to produce nanocrystalline alloys. The HPT alloys are subsequently annealed to produce UFG microstructure. The phase evolution and hardness in being investigated to assess the influence of HPT processing.

- **Indian Institute of Technology Madras, Chennai, India**

PhD scholar (Aug 2012 – Dec 2017)
Guide: Dr. B.S.Murty, Dept. of MME

a. Bulk and GB diffusion in HEAs:

Pioneer tracer diffusion measurements of constituent elements were carried out in CoCrFeNi and CoCrFeMnNi HEAs. The analysis showed that diffusion in HEAs is not sluggish, contrary to the core effect proposed. Ni GB diffusion in both the HEAs was measured and used to derive the GB energy values. Interdiffusion measurements, using pseudo-binary approach, were carried out to experimentally assess the thermodynamic factor for diffusion in HEAs.

b. Phase evolution and stability of HEAs:

CoCrFeNi and CoCrFeMnNi HEAs were produced by vacuum arc melting as well as mechanical alloying followed by spark plasma sintering. Thermal stability of all the alloy samples was investigated in the temperature range 800 – 1100 ºC. XRD, SEM and EBSD were the major tools used by me to characterize the phase structure in as-processed and heat-treated alloys. APT and TEM studies were done in collaboration with other research groups to gain deeper insights into the aspects of phase evolution.

M.Tech Project (Aug 2009 – May 2010)
Guide: Dr. B.S.Murty, Dept. of MME

a. Nanocrystalline multiferroic composites:
The project aimed at studying the magnetoelectric properties of Nano Multiferroic Composites of Copper modified Nickel Zinc Ferrites and Barium Titanate, and comparing them with corresponding microcrystalline materials. The work involved reduction of crystallite size of ferrites and barium titanate separately by high energy milling, subsequently mixing them to form Nanocomposites and then studying the properties such as magnetoelectric response and magnetization.

INDUSTRIAL EXPERIENCE:

- **ESSAR Steel Ltd., Surat, India**

Research & Development (July 2010 – July 2012)

The primarily role involved the development of steel products according to the service needs. Application of metallurgical principles to tailor the processing and thermo-mechanical conditions of various steel grades was required. The major successful projects included the increase in productivity of Batch Annealing Furnace by reducing annealing cycle time by 6 hours and development of hot rolled DP and HSLA steels.

JOURNAL PUBLICATIONS:

Published:

1. G. Mohan Muralikrishna, **M. Vaidya,** G. Wilde, B.S. Murty, S. V. Divinski, Tracer Diffusion in Ordered Pseudo-binary Multicomponent Aluminides, **Scr. Mater**. (Accepted) *(Impact Factor – 4.163)*

2. R. John, A. Karati, M. Garlapati, **M. Vaidya**, R. Bhattacharya, D. Fabijanic, B.S.Murty, Influence of mechanically activated annealing on phase evolution in $Al_{0.3}$CoCrFeNi high entropy alloy, **J. Mater. Sci.** *(In press) (Impact Factor – 3.442)*

3. **M. Vaidya**, A. Anupam, V. Bhardwaj, C. Srivastava, B.S. Murty, Grain growth kinetics in CoCrFeNi and CoCrFeMnNi high entropy alloys processed by spark plasma sintering, **J. Alloys. Compd.** 791(2019) 1114-1121. *(Impact Factor – 3.779)*

4. **M. Vaidya**, G. Mohan Muralikrishna, B.S. Murty, High entropy alloys by mechanical alloying: A review, **J. Mater. Res.** 34 (2019) 664-686 *(Impact Factor – 1.495)*

5. **M. Vaidya**, Guruvidyathri K., B.S. Murty, Phase formation and thermal stability of CoCrFeNi and CoCrFeMnNi equiatomic high entropy alloys, **J. Alloys Compd.** 774 (2019) 856-864. *(Impact Factor – 3.779)*

6. **M. Vaidya**, A. Karati, A. Marshal, K.G. Pradeep, B.S. Murty, Phase evolution and stability of nanocrystalline CoCrFeNi and CoCrFeMnNi high entropy alloys, **J. Alloys Compd.** 770 (2019) 1004–1015. *(Impact Factor – 3.779)*

7. **M. Vaidya**, G. Mohan Muralikrishna, S. V. Divinski, B.S. Murty, Experimental assessment of the thermodynamic factor for diffusion in CoCrFeNi and CoCrFeMnNi high entropy alloys, **Scr. Mater**. 157 (2018) 81–85. *(Impact Factor – 4.163)*

8. **M. Vaidya**, K.G. Pradeep, B.S. Murty, G. Wilde, S. V. Divinski, Bulk tracer diffusion in CoCrFeNi and CoCrFeMnNi high entropy alloys, **Acta Mater.** 146 (2018) 211–224. *(Impact Factor – 6.036)*

9. A. Karati, **M. Vaidya**, B.S. Murty, Comparison of different processing routes for the synthesis of semiconducting AlSb, **J. Mater. Eng. Perform.** 27 (2018) 6196-6205. *(Impact Factor – 1.094)*

10. **M. Vaidya**, K.G. Pradeep, B.S. Murty, G. Wilde, S.V. Divinski, Radioactive isotopes reveal a non sluggish kinetics of grain boundary diffusion in high entropy alloys, **Sci. Rep.** 7 (2017) 1–11. *(Impact Factor – 4.122)*

11. **M. Vaidya**, A. Prasad, A. Parakh, B.S. Murty, Influence of sequence of elemental addition on phase evolution in nanocrystalline AlCoCrFeNi: Novel approach to alloy synthesis using mechanical alloying, **Mater. Des.** 126 (2017) 37–46. *(Impact Factor – 4.364)*

12. **M. Vaidya**, S. Trubel, B.S. Murty, G. Wilde, S.V. Divinski, Ni tracer diffusion in CoCrFeNi and CoCrFeMnNi high entropy alloys, **J. Alloys Compd.** 688 (2016) 994–1001. *(Impact Factor – 3.779)*

13. **M. Vaidya**, S. Armugam, S. Kashyap, B.S. Murty, Amorphization in equiatomic high entropy alloys, **J. Non. Cryst. Solids.** 413 (2015) 8–14. *(Impact Factor – 2.488)*

CONFERENCE PRESENTATIONS:

Invited talks

- **M. Vaidya**, S. Sen, M. Glienke, M. M. Muralikrishna, J. Zhang, G. Laplanche, B.S. Murty, G. Wilde, S.V. Divinski "Diffusion behaviour of high entropy alloys with various solid solution structures", International conference on Diffusion in Solids and Liquids (DSL), 24th – 29th June 2019, Athens, Greece.

- **M. Vaidya**, S. Sen, M. Glienke, D. Gaertner, G. Wilde, S.V. Divinski "Bulk and grain boundary diffusion in high entropy alloys", Annual Spring meeting of DPG, 31st March – 5th March 2019, Regensburg, Germany.

International conference

- **M. Vaidya**, S. Trubel, B.S. Murty, G. Wilde and S.V. Divinski, "Diffusion in equiatomic FCC high entropy alloys". TMS Annual meeting, 14th – 18th Feb 2016, Nashville (T.N), USA (Oral Presentation).

- **M. Vaidya**, A. Prasad, A. Parakh, B.S. Murty, Phase evolution in nanocrystalline AlCoCrFeNi by varying sequence of elemental additions: Novel approach to alloy synthesis using mechanical alloying, International Conference on Metal and Materials Research (ICMR), 20th – 22nd June 2016, Bangalore, India (Poster Presentation).

- **M. Vaidya**, S. Trubel, B.S. Murty, G. Wilde and S.V. Divinski, Tracer diffusion studies in equiatomic FCC high entropy alloys, International conference on Diffusion in Solids and Liquids (DSL), 22nd – 26th June 2015, Munich, Germany (Oral Presentation).

- **M. Vaidya**, S. Trubel, B.S. Murty, G. Wilde and S.V. Divinski, Phase composition, microstructure and Ni tracer diffusion in FCC FeCrCoNi-based high entropy alloys, Annual Spring meeting of DPG, 15th – 20th March 2015, Berlin, Germany (Oral Presentation).

National conference

- **Vaidya M.**, Trubel S., Murty B.S, Wilde G. and Divinski S.V, "Ni grain boundary diffusion in CoCrFeNi and CoCrFeMnNi high entropy alloys**"**, IWHEM, 11 – 12th March 2017, Hyderabad, India (*Poster Presentation*)

- **Vaidya M.**, Kumar A. and Murty B.S, "Phase evolution in nanocrystalline CoCrFeNi-based equiatomic high entropy alloys", NMD-ATM, 13 – 16th Nov 2015, Coimbatore, India (*Oral Presentation*)

ACADEMIC ACHIEVEMENTS:

- **Outstanding Reviewer Award** for SCI indexed journal "Journal of Alloys and Compounds" (Impact factor – 3.133)
- Received **best publication award** from Dept. of MME, IIT Madras for the paper titled "Ni tracer diffusion in CoCrFeNi and CoCrFeMnNi high entropy alloys" published in Journal of alloys and compounds (2016)
- Received **best paper award** at In-house symposium – 2017, organized by Dept. of MME, IIT Madras
- Received **DAAD sandwich scholarship** to pursue part of my research work at University of Muenster, Muenster, Germany (June 2014 – Sep 2015)
- Received **Institute Silver Medal** for securing best academic record in Metallurgical & Materials Engineering (Dual Degree) in period 2005-2010.
- Received **DAAD scholarship**, WISE-2009, to do an internship in Germany

EXTRA CURRICULAR ACTIVITIES:

- Won third prize in Materials Science quiz organized at International Symposium for Research Scholars (ISRS-2016) during 21 – 23rd Dec 2016
- Organizing committee member for International Symposium for Research Scholars (ISRS-2012) and conference on Advances in Naval Materials -2013
- Coordinated Quiz Contest which was a part of International Conference on Advances in Manufacturing Technology (ICAMT) - 2009.

REFEREES:

- **Prof. B.S. Murty (PhD Supervisor)**
  Director,
  Indian Institute of Technology Hyderabad, Hyderabad, India
  Email: bsm@iith.ac.in
  Tel: +91-40-23016002

- **PD Dr. Sergiy Divinski (Post doc Supervisor)**
  Institute of Materials Physics
  University of Muenster, Muenster, Germany
  Email: divin@wwu.de
  Tel: +49-261-83339030