Curriculum Vitae

Dr. Khushbu Dash
Postdoctoral Research Associate

Indian Institute of Science
Non-equilibrium Processing and Nano-materials Lab
Department of Materials Engineering
Bangalore-560012, INDIA

Post-Doctoral Research Experience:

Post-Doctoral Research Associate	**Indian Institute of Science, Bangalore, India**
Department:	Department of Materials Engineering
Duration:	From November 2015 - present
Mentor:	Prof. Satyam Suwas and Prof. Kamanio Chattopadhyay
Project Title:	Fabrication and characterization of bimetallic multilayered composites: an emphasis on microstrcture and texture
Post-Doctoral Fellow	**University of Oxford, Oxford, United Kingdom**
Department:	Oxford Materials
Duration:	November 2014 - September 2015
Mentor:	Prof. Keyna O'Reilly and Prof. Marina Galano
Project Title:	Oxidation and bonding of Aluminium alloys
Visiting Researcher	**Charles University in Prague, Czech Republic**
Department:	Department of Physics of Materials
Duration:	April 2014 - October 2014
Mentor:	Prof. Pavel Lukac and Prof. Zuzanka Trojanova
Project Title:	Deformation analysis of Mg-BN nanocomposites

Research Interests:

- Copper, Magnesium and Aluminium based Metal Matrix Nanocomposites : Processing, Characterization, Interface study.
- Oxidation of aluminium alloys
- Bimetallic composites : Processing, texture, microstructure
- Mechanical properties of alloys and composites
- Thermal Residual Stress in Composite Materials

Hands on experience on using instruments

- Metallography
- Scanning electron microscope
- Field emission scanning electron microscopy
- Transmission electron microscopy
- Arc melting
- Suction casting
- Handling small molten area
- Powder metallurgy
- Spark plasma sintering
- Nanoindentation technique
- Thermogravimetric analysis for oxidation studies
- Electron microprobe analyser
- Dilatometer
- Internal friction

Research publications:

DISSERTATIONS:

1. *Processing and characterization of Cu-Al_2O_3 and Al-Al_2O_3 composites: an evaluation for micro- and nano-particulate reinforcements*, **Ph.D. thesis** submitted on 10^{th}January, 2014.
2. *Microemulsion mediated synthesis of metal-semiconductor nanocomposites*, M.Sc.(Chemistry) Dissertations, July 2008
3. *A Study on Mn doping in ZnO Nanocrystals*, Summer Training Project, May to July 2007

PEER-REVIEWED SCIENTIFIC JOURNALS:

1. K. Dash and B.C. Ray, *Evaluation of flexural behaviour of thermally and cryogenically conditioned Al-Al2O3 micro- and nano-composites at in-situ and ex-situ environments*, **Journal of Materials Engineering and Performance**, 27 **(2018)** 3678-3687.
2. Z. Trojanova, K. Dash, K. Mathis, P. Lukac, and A. Kasakewitsch, *Elastic and Plastic Behavior of an Ultrafine-Grained Mg Reinforced with BN Nanoparticles*, **Journal of Materials Engineering and Performance**, 27 **(2018)** 3112-3121.
3. K. Dash and B.C. Ray, *Implications of degree of thermal shock on flexural properties of Cu-Al_2O_3 micro- and nano-composites*, **Journal of Material Engineering and Performance**, 25 **(2016)** 259–266.
4. K. Dash, S. Sukumaran, B.C. Ray, *Thermal attributes of aluminium based composites-a review*, **Science and Engineering of Composite Materials**, 23 **(2016)** 1–20.
5. K. Dash, D. Chaira and B.C. Ray, *Microstructural investigation and wear studies on copper-alumina micro- and nano-composites fabricated by spark plasma sintering*, **Journal of Mechanical Behaviour of Materials**, 24 **(2015)**, 25–34.
6. Z Trojanova, P Palcek, A Soviarova, M Chalupova, K Dash, M Knapek, *Internal friction associated with the microstructural changes in an AZ91 magnesium alloy*, **Kovove Mater**, 53 **(2015)**, 1–6.
7. K. Dash, *Microscopic evolution in composite powder intermixing process*, **Microscopy and Analysis(2015)**.
8. K. Dash, S. Panda and B.C. Ray, *Effect of thermal and cryogenic conditioning on flexural behavior of thermally shocked Cu-Al_2O_3 micro- and nano-composites*, **Metallurgical and Materials Transactions A**, 45 **(2014)** 1567-1578.Cited by 2
9. S. Panda, K. Dash and B.C. Ray, *Processing and properties of Cu based micro- and nano-composites*, **Bulletin of materials science**, 37 **(2014)**, 227–238. Cited by 13
10. K. Dash, D. Chaira, B.C. Ray, *Synthesis and characterization of aluminium-alumina micro- and nano-composites by spark plasma sintering*, **Materials Research bulletin**, 48 **(2013)** 2535–2542. Cited by 39
11. K. Dash, S. Panda and B.C. Ray, *Process and progress of sintering behavior of copper-alumina composite*, **Emerging Materials Research**, 2 **(2013)** 32–38. Cited by 7
12. K. Dash, B.C. Ray and D. Chaira, *Synthesis and characterization of copper-alumina metal matrix composite by conventional and spark plasma sintering*, **Journal of Alloys and Compound**, 516 **(2012)** 78—84. Cited by 54
13. G. Wu, K. Dash, M.L. Galano, KAQ O'Reilly, *Oxidation studies of Al alloys: Part I Al-Cu alloy*, under review,CORSCI-2018-2225.
14. G. Wu, K. Dash, M.L. Galano, KAQ O'Reilly, *Oxidation studies of Al alloys: Part II Al-Mg alloy*, under review, CORSCI-2018-2239.
15. K. Dash, A. Dash, O. Guillon, S.Suwas and J. Gonsalez, *Design and properties of Cu-Ti2AlC in-situ (2D-TiC) composite*, manuscript under preparation.
16. K. Dash, S.Suwas and K. Chattopadhyay, *Hot co-deformation of Cu/Ta bimetallic multilayer composite*, manuscript under preparation.

17. K. Dash and S.Suwas, *Mechanical response of Mg/Zn multilayers at room temperature*, manuscript under preparation.

PEER-REVIEWED CONFERENCE PROCEEDINGS:

1. Z Drozd, Z Trojanová, U Arlic, A Kasakewitsch, K Dash*Effect of hexagonal boron nitride and graphite nanoparticles on the mechanical and physical properties of magnesium*, **38th Risø International Symposium on Materials Science** , 28^{th} July–2^{nd} August, 2017, Riso. Italy.
2. K. Dash, S. Gupta, S. Gupta and B.C. Ray, *Effect of thermal shock on the microstructure and mechanical properties of Cu-Al_2O_3 composites*, **International conference on recent advances in composite materials**, Feb 18th-21st 2013, Goa, India.
3. K. Dash, S. Panda and B.C. Ray*A study on thermal shock response of Al-Al_2O_3 micro-and nanocomposites*, **19th- International conference on composite materials**, 28^{th} July–2^{nd} August, 2013, Montreal, Canada.

CONFERENCE PRESENTATIONS WITH PUBLISHED ABSTRACTS:

1. K. Dash, S.Suwas and K. Chattopadhyay, *Interface study of Cu/Ta bimetallic multilayer composite*,ICONSAT 2018 IISc, Bangalore
2. Z. Trojanova, Z. Drozd, K. Dash, K. Mathis, P. Lukac, W. Riehemann and A. Kasakewitsch, *Mechanical and Thermal Properties of an Ultrafine-Grained-Magnesium Reinforced with BN Nano-particles*, International symposium on physics of materials, 31-August to 4-September, 2014, Charles University, Prague, Czech republic.
3. K. Dash, S. Gupta, S. Gupta and B.C. Ray, *Effect of sintering temperature on Al-Al_2O_3 composites fabricated by powder metallurgy route*, National Metallurgical Day-Annual Technical Meeting Nov-2012, Jamshedpur, India.
4. K. Dash, S. Panda and B.C. Ray, *Failure analysis of Cu-Al_2O_3 composites with the variation of reinforcement particle size and content*, International conference on strength of materials, Aug 19-24, 2012, IISc Bangalore, India.
5. K. Dash, D. Chaira and B.C. Ray, *Comparative study of Al-Al_2O_3 Micro- and Nano-composites Prepared by Powder Metallurgy Route*, International Conference on Nanoscience + Technology (ICNT) 2012, 23-27 July, Paris, France.
6. K. Dash, D. Chaira and B.C. Ray, *Characterization of SPS sintered Cu-Al_2O_3 metal matrix nano-composites*, ICAMMP, Dec 9-11, 2011, , IIT Kharagpur, India.
7. K. Dash, D. Chaira and B.C. Ray, *Microstructural Studies of Al-Al_2O_3 Nanocomposites Prepared by Powder Metallurgy Route*, National Metallurgical Day-Annual Technical Meting Nov-2011, Hyderabad, India.
8. S. Panda, K. Dash and B.C. Ray, *A Study on Microstructure and Mechanical Behaviour of Cu-Al_2O_3 composites: an Explanation by Deformation Theory*, National Metallurgical Day-Annual Technical Meting Nov-2011, Hyderabad, India.
9. K. Dash, S.Suwas and K.Chattopadhyay, *Bimetallic multilayered composite:a study on immiscible Cu/Ta system*, ICONSAT, March 2018 IISc Bangalore, India.

Teaching Experience:

Teaching Assistant	**NIT, Rourkela, India** [July 2009 - January 2014]
Department :	Metallurgical and Materials Engineering
Courses :	Practicals and tutorials in Composite Materials, Metallography, Characterization of Materials
Lecturer	**FIIT-JEE Institute, New Delhi, India** [August 2008 - July 2009] **[premier institute for training competitive A-level students]**
Department :	Chemistry
Courses :	Physical Chemistry, Organic Chemistry

Research Mentorship Experience:

Master Dissertations:	**At National Institute of Technology, Rourkela, India**
Sujata Panda :	A study and deformation behaviour of Cu-Al_2O_3 with variation of size and volume fraction of reinforcement particle
Suvin Sukumaran :	Effects of quenching media on the mechanical properties of Al-Al_2O_3 metal matrix composite

Academic Achievements:

- **National postdoctoral fellowship (2017)** to pursue postdoc in Indian Institute of Science, Bangalore in January 2017.
- Awarded seal of excellence for securing a score of 89 percent for the **Marie Curie project proposal (2017)** written with University of Oxford.
- **Erasmus Mundus postdoctoral fellow (2014)**, by the European Community Mobility Programme, Georg-August-Universität Göttingen, Germany
- CSIR Travel grant for international conference at Montreal, Canada, 2013
- Qualified in CSIR-UGC-NET(National Eligibility Test) for lectureship and research fellowship awarded by Council of Scientific and Industrial Research and University Grants Commission in June 2008.
- Summer research fellowship awarded by Indian Academy of Sciences, Bangalore in 2007.
- Secured 3rd position in M.Sc (Chemistry) in institute level.

Professional Affiliations and Services:

Peer reviewer:

- Tribology International, Journal of Alloys and Compounds, Science and Engineering of Composite Materials, Indian Journal of Engineering & Materials Sciences, World Journal of Engineering and Physical Sciences, Journal of Engineering Research and Design, Results in Physics

Professional Member:

- Indian Institute of Metals, Material Research Society

Research Outreach activities:

Poster Presentation:	**CSIR foundation day, IMMT Bhubaneswar, 26th Sept, 2011**
Title:	A micromechanics approach to evaluate the interface of metal matrix composites
Achievement:	Winner of the new idea poster competition
Workshop Attended :	
Recent Advances in Thermal Analysis of Polymers and Composites :	Dept. of Rubber Technology, IIT Kharagpur, Kharagpur, India (April, 2011)
The Theory and Characterisation of Dislocations' Hirschfest Symposium to Mark the 90th Birthday of Professor Sir Peter Hirsch FRS :	Department of Materials, University of Oxford (April 14, 2015)
Workshop on Atom Probe Tomography :	Indian Institute of Science, Bangalore, India (April, 2016)
International Conference on Metals and Materials Research :	Indian Institute of Science, Bangalore, India (June, 2016)

Member of Organizing Committee :	**(Conference or Workshop)**
National conference on processing and characterization of materials :	National Institute of Technology, Rourkela, India (December, 2011)

Education:

Ph.D. 2009–2014	**National Institute of Technology, Rourkela**
Subject:	Metallurgical and Materials Engineering
Advisor:	Prof. Bankim Chandra Ray and Prof. D. Chaira
Thesis Title:	Processing and characterization of Cu-Al_2O_3 and Al-Al_2O_3 composites: an evaluation for micro- and nano- particulate reinforcements
M.Sc. 2006–2008	**National Institute of Technology, Rourkela**
Subject:	Chemistry
Project Advisor:	Prof.G. Hota
Thesis Title:	Microemulsion mediated synthesis of metal-semiconductor nanocomposites

Pre-Ph.D. Research summary – M.Sc(Chemistry) & Summer Research Training :

The project was a precise study on doping of manganese in zinc oxide nanocrystals. In this project we have studied the optical properties of zinc oxide nanoparticles when undoped and doped with different percentages of manganese ion. We have synthesized Mn doped and undoped zinc oxide nanocrystals and subsequently studied the optical properties using UV-Visible absorption spectroscopy and X-Ray Diffraction. We synthesized Mn doped zinc oxide nanoparticles with dopant ion of different content and also calculated the diameter of the particles using Scherrer formula and we also got information about the band gap of the material. Our study also consists of another experiment on the Diffusion of Mn ion from zinc oxide nanocrystal lattice by time treatment at an elevated temperature which was confirmed by XRD plots, this process is known as self annealing. In my Masters project I have studied metal-semiconductor nanocomposite. Silver-cadmium sulphide was synthesized by microemulsion technique. I had synthesized Ag-CdS nanocomposite by three different methods via reverse micelle technique. The methods consist of mixing microemulsions of silver salt and cadmium salt and then reducing silver salt by sodium borohydride microemulsion and then conversion of cadmium salt to its sulphide by adding ammonium sulphide microemulsion. Subsequently I treated the nanocomposites formed with different concentrations of acid to remove the core of the nanocomposite i.e. silver in this case to form cadmium suphide hollow sphere which is known as a nanocapsule which has been characterized with suitable techniques.

Ph.D. Research summary :

The preliminary part of the work consists of evaluation of the effect of processing parameters on the properties of Cu-Al_2O_3 and Al-Al_2O_3 composites. The effect of blending and milling processes (powder mixing techniques) on the distribution, particle size and sintering response of Cu-Al_2O_3 and Al-Al_2O_3 composites were studied. The effect of sintering atmosphere on the microstructure and mechanical properties of Cu-Al_2O_3 composites have been discussed too. Nitrogen, argon and hydrogen atmospheres were used for sintering and the comparison in matrix and reinforcement compatibility as well as study of microstructure and mechanical properties were made. The synthesis, characterization and mechanical properties evaluation of Cu-Al_2O_3 and Al-Al_2O_3 micro- and nano-composites fabricated by conventional and spark plasma sintering was done to compare the attributes between the traditional and advanced methods of sintering. Status of the interfacial integrity of Cu-Al_2O_3 and Al-Al_2O_3 micro- and nanocomposites with the variation in sintering temperature were investigated. The study of the effect of temperature on the process and progress of sinterability of the reinforced micro- and nano-particles in the matrix. Spark plasma sintering rendered high densification, microhardness and wear resistance to the composites improving the physical integrity of matrix and reinforcement to an appreciable extent in comparison to conventional method of sintering. Copper and aluminium based composites find applications in aerospace and automobile sectors. These applications demand accelerated weathering study on these composites. Induced thermal stresses in these composites would affect the structural integrity and mechanical properties. The assessment of these variations would enable us to predict the behaviour of these composites in harsh and hostile conditions. Flexural test was used to explore the effect of thermal treatments i.e. high temperature and cryogenic environments on the mechanical property of Al_2O_3 particulate reinforced Cu and Al metal matrix micro- and nano-composites. Micro-

and nano-composites were thermally shocked from positive to negative (down thermal shock) and negative to positive temperature (up thermal shock). The fractured samples were studied under field emission scanning electron microscopy. The improvement in flexural strength of thermally shocked and conditioned samples are discussed in the light of fractography.

Post-**Ph.D.** Research summary :

Charles University in Prague : [Collaborators: Prof. Zuzanka Trojanová and Prof. Pavel Lukáč]

While pursuing postdoc in Charles University in the department of physics of materials, I was majorly working on Mg and Al based alloys and nanocomposites. The tensile and compressive properties of Mg based nanocomposites at ambient as well as high temperature yielded appreciable results. The thermal expansion was studied in pre-stressed specimens and reported. Internal friction of Mg based alloys were measured to predict the damping behaviour at different temperatures. Cu based micro- and nano-composites were investigated for their micro-deformation behaviour and thermal expansion at different heating rates along with internal friction measurements.

Oxford University : [Collaborators: Prof. Keyna O'Reilly and Prof. Marina Galano]

Oxidation of Al alloys is a self-intriguing topic and at the University of Oxford I was exposed to the field of studying oxidation behaviour of Al alloys. The oxidation of Al alloys was studied with the aid of microscopy, X-ray photoelectron spectroscopy and developing kinetic and thermodynamic oxidation models. The oxidation behaviour of Al alloys would predict the conditions in which oxides would be formed, their phase transformations and mechanical strength which would lead us to comprehend about bonding two different Al alloys for enhanced performance of one over the other and also controlling the cost-effectiveness of the bonded structure. Aluminium oxidises very readily and can take the form of a number of different oxides, amorphous and crystalline, in particle or film morphologies or in combinations. The presence of an oxide inhibits bonding but manipulation of the nature of the oxide can improve the bonding. I investigated the rate of oxidation, the thickness of the oxides formed and the crystalline-types, compositions and morphologies of the oxides formed. We are perhaps the first laboratory in the world to have successfully dissolved away the aluminium from the oxide, so allowing detailed observation of the three-dimensional morphology of both sides of the oxide layer using electron microscopy techniques.

Indian Institute of Science, Bangalore : [Collaborators: Prof. Satyam Suwas and Prof. Kamanio Chattopadhyay]

Accumulated roll bonding of immiscible and euectic bimetallic systems to fabricate multilayers which are studied for texture, microstructure and microtexture. The deformed and recrystallised microstructures are analysed in detail using EBSD to study the interface formed during bonding. Strain mapping describes strain distribution while co-deforming various immiscible and eutectic bimetallic systems. The interface of the bimetallic systems are investigated using TEM showing diffusion of metals at the bond as well as formation of intermetallics at interface. Orientation relationship and misorientation at the interface has been elaborated to explain the co-deformation process in correlation to the strain gradient generated during ARB.