



BIO-DATA

1. Name: DR. BHARAT BHUSHAN JHA
2. Date of Birth: 31.10.1959
3. Current Position and Address: **Visiting Faculty, Department of Metallurgy and Materials Engineering, NIT Jamshedpur, Ex-Chief Scientist and Head, Business Development and Standardisation Division, Advanced Mechanical and Materials Characterisation Division and Glass Division**
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4. Educational Qualifications:

Sl. No.	Degree	Institute/University	Year	Main subject/Discipline
1.	B.Sc. Engg. (Metallurgy)	Ranchi University	1982 (Rank II in University)	Physical Met., Mechanical Met., Failure Analysis, Materials Characterisation etc. (Total 32 Subjects)
2.	M.S. (Metallurgy)	Indian Institute of Technology (IIT), Madras	1989	Nondestructive testing, Corrosion science, Failure analysis, Oxidation of Metals etc. (Total 6 Subjects)
3.	Diploma in Management (DIM)	Indira Gandhi National Open University (IGNOU), New Delhi	1994	Principles of Management, Managerial economics etc. (Total 6 Subjects)
4.	Post Graduate Diploma in Management (PGDIM)	IGNOU, New Delhi	1995	Leadership theory, Industrial management etc. (Total 7 Subjects)
5.	Post Graduate Diploma in Marketing Management (PGDMM)	IGNOU, New Delhi	1996	Marketing Principles, Product marketing, Product development etc. (Total 16 Subjects)

6.	Ph.D (Metallurgy)	Institute of Technology, Banaras Hindu University, Varanasi, India	2008	Title “Investigation on Oxidation Behavior and Microstructural Degradation in 2.25Cr-1Mo steel”
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5. Academic / Research Experience / Employment

Sl. No	Organization/Institute	Grade/Post	Duration	Nature of duties
1.	Bhabha Atomic Research Centre, (BARC), Mumbai	Trainee for “one year orientation course in Nuclear Engineering”	01.08.1982 to 01.08.1983	Courses in Basics of Nuclear Metallurgy, Nuclear Engg., Fuel fabrication, inspection and reprocessing etc. (Total 22 Subjects)
2.	Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam	Scientific officer ‘C’	01.08.1983 to 01.08.1986	R&D in Non-destructive characterization and evaluation of metals and alloys. Use of SEM/TEM for materials characterization.
3.	Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam	Scientific officer ‘SD’	01.08.1986 to 29.05.1991	R&D in Acoustic emission during corrosion, plastic deformation of metals and alloys. Operation of universal testing machine.
4.	Central Mechanical Engg. Research Institute (CMERI), Durgapur, WB	Scientist ‘E-I’	30.05.1991 to 29.05.1996	R&D in use of non-destructive techniques for evaluating the materials degradation as a result of service exposure.
5.	Central Mechanical Engg. Research Institute (CMERI), Durgapur, WB	Scientist ‘E-II’	30.05.1996 to 29.05.2002	Residual life assessment of high temperature components using non-destructive evaluation and use of SEM/TEM/ EPMA for characterization of microstructures.
6.	Institute of Minerals and Materials Technology (IMMT), Bhubaneswar	Scientist ‘F’	30.05.2002 -29.05.2008	R&D in structure-property correlation ship of high temperature materials using universal testing machine, SEM/XRD/TEM/EPMA etc. including characterization of degraded microstructures due to high temperature creep, corrosion and

				erosion.
7.	Institute of Minerals and Materials Technology (IMMT), Bhubaneswar	Scientist 'G'/ Chief Scientist and Head, Surface Engineering Division	30.05.2008 – 04.12.2016	R&D in structure-property correlation ship of high temperature materials using universal testing machine, SEM/XRD/TEM/EPMA etc. including characterization of degraded microstructures due to high temperature creep and superplasticity study of Ti alloys including corrosion and erosion studies. Thermal Barrier coatings development for high temperature alloys
8.	Central Glass and Ceramic Research Institute, Kolkata	Chief Scientist and Head, Business Development and Standardization Division	5.12.2016-31.10.2019	Materials characterization of degraded microstructures due to high temperature creep of Ti alloys including corrosion and erosion studies. Thermal Barrier coatings development for high temperature alloys and facilitation in commercialization of coating technologies
9.	National Institute of Technology(NIT), Jamshedpur	Visiting Faculty	13.11.2019-Continuing	Taking courses for UG and PG program of the institute and mentoring research fellows and facilitating research activities in the department through fostering collaborative programs.

6. Area of Specialization:

Mechanical Metallurgy: Mechanical behavior of materials at ambient, high and low temperature under slow and nominal strain rate. Effect of material chemistry, microstructure, cold work, temperature, prior deformation etc. on the mechanical behavior of metals, alloys, composites (metal-matrix and ceramic matrix composites). Mg & Al based alloys and composites developments.

Physical Metallurgy: Structure-Property relationship of metals and alloys, characterization of degraded microstructure using SEM, XRD, TEM, EPMA etc. Residual life estimation by measuring the degraded properties of materials including non-destructive characterization of material properties.

Chemical Metallurgy: High temperature oxidation of metals and alloys, effect of rare earth element additions, use of oxide scale thickness in residual life assessment of materials operating at high temperatures. Hot corrosion under boiler operating conditions and erosion studies of high temperature materials.

Tribology: Thermal Barrier coatings development for high temperature alloys and facilitation in commercialization of coating technologies. Friction and wear properties of metals, alloys, ceramics and composites.

7. Honors/Awards received:

Sl. No	Name of Awards, Honors	Year	Contributions for which awarded
1.	Best Metallurgist Award, Durgapur Chapter of Indian Institute of Metals	1993	Residual life assessment of power plant components
2.	Second best paper Award in ferrous group of 56 th Annual Technical Meeting of Indian Institute of Metals held at Baroda	2002	Residual life estimation of super heater and reheater tubes based on oxide scale thickness measurement
3.	INSA fellowship under INSA-DFG exchange scientist program	2012	Mechanical characterisation of composites through miniature specimen techniques
4.	CSIR-DAAD fellowship (Senior)	2010	Oxide scale adherence study of low alloy steel under thermal cyclic condition
5.	2nd Berger Award for Excellence in Coating Research and Promotion by The Society for Surface Protective Coatings, India	2015	Contribution in the Development of Surface Engineering and its Research and Promotion.
6.	NACE International Gateway India Section (NIGIS) Corrosion Awareness Award -2016	2016	For significant contributions in the field of Surface Science and Engineering through high temperature oxidation of metals, alloys, ceramics and composites including Thermal Barrier Coatings development for aerospace applications.

8. Professional Affiliations:

Sl. No	Professional bodies	Membership
1.	Indian Institute of Metals (IIM), Kolkata	Life Member
2	Indian Institute of Welding (IIW), Kolkata	Life Member
3.	Indian society for Non-destructive testing (ISNT)	Member
4	Acoustic Emission Working Group (India), AEWG(I)	Member
5.	Society For Failure Analysis (SFA), India	Member, Executive Committee
6.	Society for Surface Protective Coatings(SSPC), India	Member, Executive Committee
7.	Powder Metallurgy Association of India	Life Member
8.	Electron Microscope Society of India	Life Member
9.	Materials Research Society of India (MRSI)	Life Member
10	Indian Ceramic Society Kolkata	Life Member

Visits Abroad:

Sl. No	Place of Visit	Duration	Period	Purpose
1.	MPA, Stuttgart, Germany	15.08.1986 to 14.12.1986	Four months	Trainee, for reprocessing of Nuclear Fuel
2	IEF-2, Juelich, Germany	15.01.2010 to 31.01.2010	15 days	Visiting scientist for R&D on High Temperature Oxidation and Residual Life Assessment of T22 Steel
3.	Institute of Mechanics, Lomonosov Moscow State University, Russia, Moscow	15.06.2010 to 29.06.2010	15 days	Experimental and Theoretical Investigations of the Mechanical Behavior and the Evolution of Structure for the Alloys under Non-stationary Process of Superplastic Deformation
4.	IEF-2, Juelich, Germany	24.07.2010 to 24.09.2010	2 months	Visiting scientist for R&D on High Temperature Oxidation of heat resistant alloys
5.	University of Leeds, UK	06.09.2010 to 10.09.2010	Five days	Visiting scientist
6.	Institute of Complex Materials (IKM), Dresden, Germany	20.10. 2011 to 05.11.2011	15 days	Visiting scientist
7.	IEK-2, Juelich, Germany	10.01. 2012 to 28.02.2012	50 days	Visiting scientist for R&D on High Temperature Oxidation of heat resistant alloys
8.	OVGU Magdeburg, Magdeburg, Germany	01.06.2012 to 31.07.2012	60 days	Visiting scientist for R&D on Mechanical behavior of polymer matrix composites

9.	IEK-2, Juelich, Germany	18.03. 2013 to 18.04.2013	30 days	Visiting scientist for R&D on High Temperature Oxidation of heat resistant alloys
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9. *(a) Number of Research Publications: 83 (Attached as Annexure – I)
 (b) List of presentations (109), invited talks (25) and projects carried out as leader (35): Attached as Annexure – II
 (d) Highlights of significant contributions: Enclosed as Annexure –III

10.* Number of Books / proceedings authored/edited:

1. **B.B. Jha** and S.K. Srivastava (Editors)
 Proceeding Conference on “**Life Prediction and Extension Techniques for Thermal Power Plants (LPET – 2003)**”, January 16-17, 2003, National Power Training Institute (NPTI), Durgapur, India
2. **B.B. Jha**, R.K. Galgali and V.N. Misra (Editors)
 Proceeding Conference on **National Seminar on “ Futuristic Materials” (NSFM-2004)**, April 21-22, 2004, held at RRL, Bhubaneswar, Allied publishers Pvt. Ltd., New Delhi, April 2004.
3. **B.B.Jha**, A.K. Chaubey, U.Balaji and B.K.Mishra (Editors)
 Proceeding International Conference on Emerging Materials and Processes (ICEMP-2014) held at CSIR-IMMT, Bhubaneswar on 26-27th February 2014, CSIR- Institute of Minerals and Materials Technology Bhubaneswar-751013, Odisha, India, ISBN: 978-81-928552-1-9.

11. a) Number of Patents granted/applied for: NIL
 b) Technologies developed, licensed and/or commercialised : Developed - Two

12. Dissertations supervised: TWO
 (a) Ph.D.: Two (continuing)
 (b) Post Graduation: NINE

13. List of address/phone/email etc. of at least five professional referees familiar with candidate’s contributions who can be referenced with candidate’s qualities and potential:

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Place: Jamshedpur

Signature of the Applicant

LIST OF PUBLICATIONS : National/International (83):

1. A.S. Khanna, **B.B. Jha** and Baldev Raj: “Detection of breakaway oxidation and spalling in the oxide scale of 2.25 Cr 1Mo steel using AE technique”, **Oxidation of Metals, Vol. 23, No.3/4, pp. 159-176, 1985.**
2. **B.B Jha**, Baldev Raj and A.S Khanna: “Frequency analysis of AE signal obtained during breakaway oxidation and internal cracking of 2.25 Cr 1Mo steel at 900 °C”, **Oxidation of Metals, Vol. 26, No. 3/4, pp. 263-273, 1986.**
3. **B.B Jha**, Baldev Raj and A.S Khanna: “Characterization of frequency spectrum of Acoustic Emission signals obtained during oxidation of a ferritic steel”, **Trans. of The Indian Institute of Metals, Vol.40, No.2, pp. 176-178, 1987.**
4. A.S. Khanna, **B.B. Jha** and Baldev Raj: “Application of Acoustic Emission to study the scale integrity during high temperature oxidation of metals”, **Quality Evaluation, pp. 11-12, July-Sep. 1987.**
5. A.S. Khanna, **B.B. Jha** and Baldev Raj: “Acoustic Emission Technique – An alternate method to study the brittle oxide scale formed on copper”, **Oxidation of Metals, Vol. 27, No.1/2, pp. 97-104, 1987.**
6. **B.B Jha**, A.S Khanna and Baldev Raj: “Study of the oxidation behavior of 9Cr-1Mo using acoustic emission technique”, **Journal of Mat. Sci. Vol. 22, No. 8, pp. 2823-2827, 1987.**
7. A.S. Khanna, **B.B. Jha** and Baldev Raj: “The application of Acoustic Emission technique in high temperature oxidation studies”, **Journal of Acoustic Emission, Vol. 6, No. 4, pp. 209-214, 1987.**
8. A.S. Khanna, **B.B. Jha** and Baldev Raj: “Application of Acoustic Emission Technique in High temperature oxidation Studies”, **Proc. Tenth International congress on Metallic Corrosion, pp. 3443-3451, 7-11 Nov. 1987, Madras, India.**
9. Baldev Raj, T. Jaykumar, P. Kalynasundaram, P. Barat, **B.B. Jha**, D.K. Bhattacharya and P. Rodriguez: “Comparative studies on Acoustic emission generated during Luder’s Deformation in mild steel and Portevin – Le chatelier effect in Austenitic stainless steel”, **Journal of Acoustic Emission, Vol. 8, No.1/2, pp. s149-s153, 1989.**
10. Baldev Raj, **B.B. Jha** and P. Rodriguez: “Frequency spectrum analysis of Acoustic Emission signal obtained during tensile deformation and fracture of an AISI 316 type stainless steel”, **Acta Metallurgica, Vol. 37, No. 8, pp. 2211-2215, 1989.**

11. **B.B. Jha**, Baldev Raj, A.S. Khanna, D.K. Bhattacharya and K.J.L. Iyer: “Correlation of Acoustic Emission events with parabolic oxidation behavior of 2.25 Cr-1Mo steel”, **Journal of Materials Science letters**, Vol. 10, No. 2, pp. 64-66, 1990.
12. Baldev Raj, **B.B. Jha**, A.S. Khanna, and D.K. Bhattacharya: “Acoustic Emission studies towards better understanding of high temperature oxidation in Cr-Mo steels”, **The International Journal of Pressure Vessels and Piping** , Vol. 45, No. 3, pp. 301-326, 1991.
13. **B.B. Jha**, Baldev Raj, A.S. Khanna, D.K. Bhattacharya and K.J.L. Iyer: “Acoustic Emission as a technique to study breakaway oxidation and spalling behavior of 2.25 Cr-1Mo steel”, **Journal of Materials Science**, Vol. 26, No.16, pp. 4455-4460, 1991.
14. Baldev Raj and **B.B. Jha**: “Acoustic Emission–I: Fundamentals of Acoustic Emission”, **Journal of Non-destructive Evaluation**, Vol. 12, No. 1, pp. 37-47, 1992.
15. Baldev Raj and **B.B. Jha**: “Application of Acoustic Emission in Materials Research”, **Journal of Non-destructive Evaluation**, Vol. 12, No. 2, pp. 29-46, 1992.
16. Baldev Raj and **B.B. Jha**: “Fundamentals of Acoustic Emission”, **British Journal of NDT**, Vol. 36, No. 1, pp. 16-23, 1994.
17. **B.B. Jha**, A.S. Khanna and Baldev Raj: “Study of spallation characteristics of oxide plate in 2.25Cr-1 Mo ferritic steel by acoustic emission technique”, **Proc. of 14th world conf. on non-destructive techniques (14th WCN DT) edited by Baldev Raj et al, New Delhi, India, Dec. 8-13, pp. 2519-2523, 1996.**
18. **B.B. Jha** and Baldev Raj: “Acoustic emission generated during tensile plastic deformation in mild steel”, **Proc. of 14th world conf. on non-destructive techniques (14th WCN DT) edited by Baldev Raj et al, New Delhi, India, Dec. 8-13, pp. 2355-2359, 1996.**
19. **B.B. Jha**: “Amplitude distribution analysis of AE signals obtained during high temperature oxidation of Zircaloy”, **Mechanical Engg. Bulletin**, Vol. 36, No. 1&2, pp. 13-17, June 1995.
20. **B.B. Jha**, A.B. Mondal and B.K. Sinha: “Role of Larson Miller parameter in assessing remaining life of 2.25 Cr-1Mo steel for Boiler applications”, **Mechanical Engg. Bulletin**, Vol. 25, No. 1&2, pp. 6-11, 1994.

21. **B.B. Jha** and Baldev Raj: “Study of spalling characteristics of oxide scale in 2.25 Cr - 1Mo ferritic steel by Acoustic Emission Technique”, **Mechanical Engg. Bulletin**, Vol. 26, No. 3&4, pp. 15-21, 1995.
22. **B.B. Jha** and S. Roy: “A practical approach to residual life assessment of power plant components”, **Proc. of International symposium on “Materials aging and life management”** Oct. 3-6, 2000, Kalpakkam, India Eds Baldev Raj, K.B.S. Rao, T. Jayakumar and R.K. Dayal, pp. 1188-1193, Allied Publishers Ltd., Chennai (2000).
23. **B.B. Jha**: “Parmanu Shakti; Urja Ka Ek Mahatwapurna shroth (In Hindi)”, **Durgapur Bharti**, Issue-2, pp. 24, 2002.
24. **B.B. Jha**, Sunita Routray and V.N. Misra: “Prospectus of power sector refurbishment in Orissa-Challenges and opportunities”, **Steel and Metallurgy**, Vol. 7, No-5, pp. 35-42, March 2005.
25. V.N. Misra and **B.B. Jha**: “Challenges and opportunities in Mineral Processing”, **Steel and Metallurgy**, Vol. 7, No-5, pp. 43-47, May 2005.
26. **B.B. Jha** and V.N. Misra: “A practical approach to access the damage process of heat resitant matrerials for power engineering”, **Steel and Metallurgy**, Vol. 7, No-11, pp 49-53, Sept. 2005.
27. **B.B. Jha**, Sunita Routray and V.N. Misra: “Prospects for growth of sponge iron industries in Orissa”, **Steel and Metallurgy**, Vol. 7, No-10, pp 34-40, Aug. 2005.
28. **B.B. Jha** and V.N. Misra: “Role of hardness measurement in remaining life prediction of high temperature components”, **Minerals and Metals Review**, Vol-31, No-7, pp. 66- 70, July 2005.
29. **B.B. Jha** and V.N. Misra: “Recent trends in residual life assessment of high temperature tubing”, **Proc. of Int. Conf on Emerging trends in Extractive Metallurgy and Mineral Processing, (ICME-2005)** edited by T.Subaiah et al, RRI, Bhubaneswar, India, June 13-14, pp. 465-473, 2005.
30. **B.B. Jha** and V.N. Misra: “Assessment of present state of health and service suitability of coach wheel discs”, **Proc. of Int. Conf on Emerging trends in Extractive Metallurgy and Mineral Processing, (ICME-2005)** edited by T.Subaiah et al, RRI, Bhubaneswar, India, June 13-14, pp. 22-34, 2005.
31. **B.B. Jha**: “An investigation towards service suitability assessment of coach wheel discs”, **Steel and Metallurgy**, Vol. 9, No-10, pp. 44-52, August 2007.

- 32. B.B.Jha, B.K.Mishra, B. Satpati and S.N.Ojha**, “Effect of Thermal Ageing on the Microstructure and Mechanical Properties of 2.25Cr-1Mo Steel”, **Material Science – Poland**, Vol. 28, No. 1 , pp. 335-346, 2010.
- 33. B.B. Jha, B.K. Mishra, B. K. Mohapatra and S.N. Ojha**, “Acoustic Emission studies during high temperature oxidation of 2.25Cr-1Mo Steel at 1173 K”, **Materials at high temperature**, Vol. 27, No. 4, pp. 301-311, 2010.
- 34. B.B.Jha, B.K.Mishra and S.N.Ojha**, “Effect of Microstructural Variation on Hardness Degradation of 2.25Cr-1Mo Steel and its Impact on Residual Life Assessment”, **Canadian Metallurgical Quarterly**, Vol. 49, No. 3, pp. 293-300, 2010.
- 35. B.B.Jha**: “Non-destructive inspection techniques for pipeline corrosion monitoring – A review”, **Steel and Metallurgy**, Vol. 11, No-4, pp. 30-40, February 2009.
- 36. B.B.Jha, B.K.Mishra and S.N.Ojha**, “Spectrum analysis of Acoustic emission signal obtained during breakaway oxidation of 2.25Cr-1Mo steel”, **Defect and Diffusion Forum**, Vol. 293, pp. 27, 2009.
- 37. B.B.Jha, B.K.Mishra and S.N.Ojha**, “Acoustic emission during isothermal oxidation of 2.25Cr-1Mo steel”, **Defect and Diffusion Forum**, Vol. 294, pp. 93, 2009.
- 38. B.B.Jha, B.K.Mishra, T.K. Sahoo, P.S. Mukherjee and S.N.Ojha**, “Effect of Microstructure on Wear Properties of 2.25Cr-1Mo Steel” **Defect and Diffusion Forum**, Vol. 303-304, pp. 85-97 , 2010.
- 39. R.K.Sahoo, B.B.Jha, T.K.Sahoo, B.K.Mishra**, “Experimental Study On Variation Of Microstructural Parameters In Near Alpha Titanium Alloys Under Non-Stationary Process Of Superplastic Deformation” **Proceedings of 4th International Conference on Computer and Electrical Engineering, ICCEE 2011 Singapore. October 14-15, 2011.**
- 40. B.B.Jha, T.K. Sahoo, D.Tripathy and B.K.Mishra**, “Assessment of Microstructural Degradation in 2.25Cr-1Mo steel using miniature Specimen Technique” **Defect and Diffusion Forum**, Vol. 319-320, pp. 25-35 , 2011.
- 41. R.K.Sahoo, B.B.Jha, T.K. Sahoo, B.K.Mishra, O.I.Bylya and M.K.Sarangi**, “A study on variation of microstructural parameters in titanium alloys during near superplastic regime of deformation”, **Applied Mechanics and Materials**, Vols. 110-116 (2012) pp 4723-4729.

- 42. K.Bhaskaran, B.B.Jha, B.K.Mishra, O.I.Bylya and M.K.Sarangi, P.V.Chystyakov, A.V. Muravlev, R.A.Vasin** “Development of a variant of scalar constitutive equations suitable for description of the near super-plastic regimes of deforming”, **Applied Mechanics and Materials, Vols. 110-116 (2012) pp 163-169.**
- 43. B.B.Jha, B.K.Mishra and S.N.Ojha,** “Oxidation Behaviour of 2.25Cr-1Mo Steel and its Characterisation using Acoustic Emission” **Canadian Metallurgical Quarterly, Volume 51, Number 2, April 2012, pp. 221-227.**
- 44. A. B. Pattnaik and B.B.Jha,** “Effect of microstructural degradation on acoustic emission during tensile deformation of 2.25Cr–1Mo steel”, accepted for publication in **Canadian Metallurgical Quarterly, Vol. 52 No. 2 (2012) 217-221.**
- 45. A. B. Pattnaik, B.B.Jha, R.Sahoo,** “Effect of strain rate on acoustic emission during tensile deformation of a-brass”, **Materials Science and Technology, Vol. 29 No. 3 (2013) 294-299.**
- 46. Sisir Mantry, Debadhyan Behera, Alok Satapathy, Bharat B. Jha, Barada K. Mishra,** “Deposition of plasma sprayed copper slag coatings on metal substrates” **Surface Engineering, 2013, Vol.29, No. 3, p.222-227.**
- 47. Sisir Mantry, Srimant K. Mishra, Debidutta Debasish, Bharat B. Jha, Barada K.Mishra,** “Erosive wear analysis of plasma sprayed cermet coatings using copper slag & Aluminium” **Tribology Transactions, 2013, Vol. 56, No.2, p. 196-202.**
- 48. R. Sahoo, S. Mantry, T. K. Sahoo, S. Mishra, B. B. Jha,** “Effect of microstructural variation on erosion wear behaviour of Ti-6Al-4V alloy, Tribology Transactions”, 2013, **Vol. 55 No. 4, 555 -560.**
- 49. R. Sahoo, B. B. Jha, T. K. Sahoo,** “Experimental study on microstructural variation in near alpha titanium alloy during non-optimal regime of superplastic deformation”, **Materials Science and Technology, 2013, Vol. 29 No. 7, 854-860.**
- 50. R. Sahoo, S. Mantry, T. K. Sahoo, S. Mishra, B. B. Jha,** “Influence of Microstructure on High Temperature Solid Particle Erosion Behaviour of Ti–6Al–4V Alloy”, **Transactions of Indian Institute of Metals,2014, vol-67, pp. 299-304 .**
- 51. R. Sahoo, B. B. Jha, T. K. Sahoo,** Dry Sliding Wear Behaviour of Ti–6Al–4V Alloy Consisting of Bimodal Microstructure, **Transactions of Indian Institute of Metals, 2014, Vol. 67 pp 239-245 .**

- 52. R.Sahoo, B.B.Jha, T.K.Sahoo**, “Experimental study on the effect of microstructure on dry sliding wear behavior of Titanium alloy using Taguchi experimental design”, **Tribology Transactions**, Volume 57, 2014, pp.216-224.
- 53. S. Sahoo, B. B. Jha, T. K. Sahoo**, “Microstructural characterisation of thermally degraded 2.25Cr–1Mo steel using ultrasonic measurement and its correlation with mechanical properties”, **Materials Science and Technology**, 2013, Vol.30, No.10, 1197-1204.
- 54. D.Debasish, S.Mantry, D.Behera, B.B.Jha**, “Improvement of microstructural and mechanical properties of plasma sprayed Mo coatings deposited on Al-Si substrates by pre-mixing of Mo with TiN powder”, **Journal of High Temperature**, 2014, Vol. 52, No.1,p 19-25.
- 55. S. Mantry, A. Mandal, D. K. Mishra, B. B. Jha, B. K. Mishra, M. Chakraborty**, Microstructure and Thermal Characterization of Plasma Sprayed Nanostructured La₂Ce₂O₇ Doped YSZ Coatings, **Journal of Thermal Spray Technology**, 2014, Vol. 23, No.7,p 1073-1080.
- 56. Sisir Mantry, B.B.Jha, A. Satapathy** “Evaluation and Characterization of Plasma Sprayed Cu Slag-Al Composite Coatings on Metal Substrates” **Journal of coatings**, Article No 842865, DOI : 10.1155/2013/842865, Hindawi Publishing corporation, 2013.
- 57. S. Mantry, R.Sahoo, B.B.Jha, B.K.Mishra, M.Chakraborty**, “Tribological studies of plasma sprayed YSZ-La₂Ce₂O₇ nanocomposite coatings”, International conference on emerging materials and processes held at CSIR-IMMT, Bhubaneswar on 26-27th February 2014, 481-485, **ISBN: 978-81-928552-1-9**.
- 58. S. K. BadJena, B.B. Jha, B.K. Mishra**, “A Finite Element Approach to Microstructure Evolution during Hot Forming Process: Accounting Recrystallization and Grain Growth Theory”, International conference on emerging materials and processes held at CSIR-IMMT, Bhubaneswar on 26-27th February 2014, 253-256, **ISBN: 978-81-928552-1-9**.
- 59. Vyjainto K Ray, Payodhar Padhi, B. B.Jha, Tapas K Sahoo**, “Study of dry sliding wear characteristics of bulk aluminium & al₂o₃ nano metal matrix nanocomposites prepared by solidification route”, International conference on emerging materials and processes held at CSIR-IMMT, Bhubaneswar on 26-27th February 2014, 506-508, **ISBN: 978-81-928552-1-9**.

60. **B.B.Jha**, M.Scheffler, S.Rannabauer, S.Mantry, R.Sahoo, B.K.Mishra, “Structure property co-relationship of glass-epoxy composites filled with copper slag under the influence of tensile loading”, International conference on emerging materials and processes held at CSIR-IMMT, Bhubaneswar on 26-27th February 2014, 357-362, **ISBN: 978-81-928552-1-9**.
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83. S. Mantry, **B.B.Jha** and R.Sahoo, “Influence of particle state diagnostics on microstructure of Plasma Sprayed nanocomposite LaCeYSZ coatings” 6th Asian Thermal Spray Conference being held at ARCI, Hyderabad on 24-26th November 2014.
84. R. Sharma, R. Sahoo, B.B. Jha, and P.S. De, “Study of growth kinetics of a thermally aged LPTR blade on application of load at high temperature”, International conference on materials science and technology held at University of Delhi during 1st – 4th March 2016.
85. B. B. Jha, R. Sahoo, T.K. Sahoo, and S.N. Ojha, “Oxidation behavior and its impact in residual life assessment of Cr-Mo steel components”, 4th International conference on Thermomechanical simulation and processing of steel (SIMPRO 16), held at RDCIS, Ranchi during 10th- 12th February 2016.
86. B.B. Jha, R. Sahoo, and T.K. Sahoo, “Microstructural characterization of Ti-6Al-4V using ultrasonic attenuation and its correlation with mechanical behavior”, 25th National seminar and International exhibition on Non Destructive Evaluation, held at Hyderabad during 26th-28th November 2015.
87. R. Sahoo, B.B. Jha and T.K. Sahoo, “Effect of Volume Fraction of Primary Alpha Phase on Solid Particle Erosion Behavior of Ti-6Al-4V Alloy” NMD ATM 2015 held at Coimbatore during 13th-16th November 2015.
88. B.B. Jha, and S. Mantry, “Plasma Sprayed Nano-structured YSZ Coatings Doped with Rare Earth Oxides: A state of the art”, 12th International Surface engineering, Paints and Coating symposium and Expo, held at New Delhi during 7th - 9th October 2015.

89. R. Sharma, R. Sahoo, B.B. Jha, T.K. Sahoo, and P.S. De, “Microstructural analysis of thermally aged LPTR blade of an aero engine”, National conference on emerging technologies for aerospace applications held at Sathyabama University, Chennai during 10th-11th April 2015
90. B.B. Jha, and S.N. Ojha, “Microstructural Characterization of Thermally Degraded 2.25Cr-1Mo steel Using Ultrasonic Measurement and Miniature Specimen Parameters including its Correlation with Wear Properties”, International Conference on Electron Microscopy, EMSI-2016 during June 2-4, 2016 held at IT, BHU Varanasi.
91. R. Sahoo, **B.B. Jha** and T.K. Sahoo, “Assessment of mechanical properties of Ti- 6Al-4V alloy by means of small punch test” International Conference on Electron Microscopy (EMSI 2016) held at IIT (BHU), Varanasi during 2nd – 4th June 2016
92. Sisir Mantry , alok Satapathy, **B.B. Jha**, B.K.Mishra “Development of plasma sprayed ceramic coatings using copper slag – A solid waste of copper refinery plant” International congress of Environmental Science & Technology, May, 2012, Argentina.
93. S. Sahoo , **B.B. Jha** , T.K. Sahoo , A. Mandal, Effect of TiB₂ reinforcement on wear performance of steel metal matrix composites produced by hot pressing method, NMD ATM 2018, Nov14-16.
94. S. Sahoo , **B.B. Jha** , T.K. Sahoo , A. Mandal, Effect of TiB₂ reinforcement on wear performance of steel metal matrix composites produced by hot pressing method, NMD ATM 2018, Nov14-16.
95. R. Sahoo, **B.B. Jha**, T.K. Sahoo and S. Bysakh, “Effect of Primary Alpha Phase Variation on Creep Behavior of Ti-6Al-4V Alloy: An Impression Creep and TEM analysis” NMD ATM 2018 held at Kolkata during 14th-16th November 2018.
96. R. Sahoo, R. Sharma, T.K. Sahoo, P.S De and **B.B. Jha**, “Morphological Stability of γ' Precipitates in a Nickel Base Superalloy: Continuous Vs. Cyclic Thermal Ageing” NMD ATM 2018 held at Kolkata during 14th -16th November 2018.
97. **B.B. Jha**, R. Sahoo and T.K. Sahoo, “Effect of volume fraction of primary alpha phase on impression creep behavior of Ti-6Al-4V alloy”, International conference on electron microscopy (EMSI 2018), Bhubaneswar, 18th -20th July 2018.
98. S. Mantry, R. Sahoo and **B.B. Jha**, “Characteristics of Plasma sprayed ceramic coatings using industrial wastes and low grade minerals”, National conference on waste to wealth in mineral and metallurgical industries (WMMI-2018) held at CSIR-IMMT, Bhubaneswar during 9th-10th March 2018.
99. R. Sahoo, T.K. Sahoo, S. Sahoo and **B.B. Jha**, “Assessment of mechanical properties of SA-213-T22 structural steel by means of small punch test”, Asia steel international conference 2018 held at Bhubaneswar during 6th-9th February 2018.

100. R. Sahoo, S. Mantry, T.K. Sahoo and **B.B. Jha** “Modeling on solid particle erosion behavior of 2.25Cr-1Mo steel”, Asia steel international conference 2018 held at Bhubaneswar during 6th-9th February 2018.
101. R. Sahoo, T.K. Sahoo and **B.B. Jha**, “Effect of volume fraction of primary alpha phase on stress exponent and activation energy of Ti-6Al-4V alloy: An impression creep study”, NMD ATM 2017 held at Goa during 11th-14th November 2017.
102. R. Sahoo, T.K. Sahoo and **B.B. Jha**, “Effect of microstructure on the creep properties of Ti-6Al-4V alloys: An analysis”, NMD ATM 2017 held at Goa during 11th-14th November 2017.
103. **B.B. Jha**, R.K. Satapathy, R. Sahoo and K. Muraleedharan, “Damage evaluation of Yttria stabilised Zirconia (YSZ) thermal barrier coatings”, International conference on electron microscopy and allied techniques (EMSI 2017) held at Mahabalipuram, Chennai during 17th -19th July 2017.
104. **B.B. Jha**, R.K. Satapathy, T.K. Sahoo and R. Sahoo, “Damage evaluation of Yttria stabilised Zirconia (YSZ) thermal barrier coatings”, 26th national seminar & international exhibition on non-destructive evaluation, held at Thiruvananthapuram during 15th -17th December 2016.
105. R. Sahoo, A.K. Chaubey, T.K. Sahoo and **B.B. Jha**, “Impression creep behavior of Mg-Nd Magnesium alloy”, International conference of young researchers on advanced materials (ICYRAM 2016) held at IISc, Bangalore during 11th-15th December 2016.
106. R. Sharma, R. Sahoo, T.K. Sahoo, **B.B. Jha**, and P.S. De, “Study of growth kinetics of a thermally aged LPTR blade on application of load at high temperature”, International conference on materials science and b technology held at University of Delhi during 1st – 4th March 2016.
107. R. Sahoo, **B.B. Jha** and T.K. Sahoo, “On the microstructural behavior of Titanium alloy during non-optimal regime of Superplastic deformation”, National conference on processing and characterization of materials held at NIT, Rourkela during 5th -6th December 2014.
108. S. Mantry, R. Sahoo, **B.B. Jha**, B.K. Mishra and M. Chakraborty, “Tribological studies of plasma sprayed YSZ-La₂Ce₂O₇ nanocomposite coatings”, International conference on emerging materials and processes held at CSIR-IMMT, Bhubaneswar on 26-27th February 2014.
109. **B.B. Jha**, M. Scheffler, S. Rannabauer, S. Mantry, R. Sahoo and B.K. Mishra, “Structure property co-relationship of Glass-Epoxy composites filled with copper slag under the influence of tensile testing”, International conference on emerging materials and processes held at CSIR-IMMT, Bhubaneswar on 26-27th February 2014.

List of Invited Talks (25):

- 1. Applications of Acoustic Emission-NDT.**
At one day seminar on “Acoustic Emission-NDT”, March 10, **1989**, VSSC Trivendrum.
- 2. An overview of RLA studies of power plant components.**
January 20, **2004**, Ib Thermal Power Station, Vanherpalli, Jharsuguda, Orissa.
- 3. Assessment of service worthiness of high temperature materials.**
At one day seminar on “Brain storming session on advance materials and applications, January 21, **2005**, State Council on Science and Technology, Govt. of Orissa.
- 4. Residual life assessment of high temperature components.**
On the eve of “National Technology Day”, May 11, **2004**, RRL, Bhubaneswar.
- 5. Service suitability assessment of components using non-destructive techniques.**
October 30, **2004**, East Coast Railways, Bhubaneswar.
- 6. Research career in Material Science.**
December 23, **2004** on the occasion of CPLYs program of CSIR.
- 7. Regain lost megawatts: a novel approach.**
On the eve of National Technology day, May 11, **2005** at NALCO, Angul.
- 8. Service suitability assessment of in-service components used in railway coaches.**
Interactive meet on service suitability assessment of in-service components held at RRL, Bhubaneswar on July 21, **2006**.
- 9. An overview of residual life assessment studies of power plant components.**
August 18, **2006**, Captive Power Plant, NALCO, Angul, Orissa.
- 10. An overview of RLA of high temperature components.**
February 22, **2008**, Ib Thermal Power Station, Vanherpalli, Jharsuguda, Orissa.
- 11. Acoustic Emission during High Temperature Oxidation of 2.25Cr-1Mo Steel.**
January 27, **2010**, Institute of Microstructure and Properties, Juelich, Germany.
- 12. Miniature specimen technology for Residual life assessment of power plant components.** January 20, **2010**, RWTH, Aachen, Germany.
- 13. Oxide Scale Adherence behavior of 2.25Cr-1Mo steel in steam environment.**
August 20, **2010**, Institute of Microstructure and Properties, Juelich, Germany.
- 14. Acoustic Emission in Materials Research.**
September 6, **2010**, Mechanical Engineering Department, University of Leeds, UK.
- 15. Determination of Failure Criteria for Industrial Superplastic Forming.** September 13, **2011**, at workshop on “Failure Analysis” organized by The Aeronautical Society of India, Sunabeda Branch, HAL, Koraput.
- 16. Miniature Specimen Technologies for Materials Evaluation,** November 2, **2011**, Institute of Complex Materials (IKM), Dresden, Germany.

- 17. Research Activities in Surface Engineering Department, CSIR-IMMT, Bhubaneswar”**
on 15th November **2011** at HAL, Koraput.
- 18. Role of Oxide Scale thickness in life evaluation of high temperature tubings,**
January 20, **2012** Institute of Energy and Climate Research (IEK), Juelich, Germany.
- 19. Mechanical characterisation of high temperature components through miniature specimen techniques.**
June 14, **2012** at Otto-Von Guericke University (OVGU), Magdeburg, Germany.
- 20. Residual life assessment of engineering components.**
November 9, **2013** at High-tech Institute of technology, Bhubaneswar.
- 21. Precipitation kinetics in low alloy steel.**
October 4, **2013** at NIT, Rourkela.
- 22. Cyclic oxidation behavior of Cr-Mo steel in steam environment.**
April 12, **2013** at Institute of Climate Research, Juelich, Germany.
- 23. Plasma Sprayed Nanostructured YSZ Coatings Doped with Rare Earth Oxides: A state of the art**
October 8, 2015 at 12th International Surface Engineering, paints and coatings Symposium 2015, New Delhi.
- 24. Materials Development program in collaboration with HAL, Koraput and CSIR-IMMT, Bhubaneswar, in Industry – Institute Partnership Meet 2015 held at KIST, Bhubaneswar on 22nd January 2016.**
- 25. Microstructural Characterization of Thermally Degraded 2.25Cr-1Mo steel Using Ultrasonic Measurement and Miniature Specimen Parameters including its Correlation with Wear Properties”, International Conference on Electron Microscopy, EMSI-2016 during June 2-4, 2016 held at IT, BHU Varanasi.**

List of projects completed (as a leader):

Sl. No	Title of the Project	Sponsors	Project cost (Rs.)	Year
1.	Assessment of present state of health and service suitability of turbo-generator components (Unit-III)	M/s Bokaro steel Ltd. (SAIL), Bokaro, Bihar	4.85 Lakhs	1992
2.	Assessment of metal conditions of turbo-generator components by non-destructive testing (Unit-III)	M/s Talcher Thermal Power Station, OSEB, Orissa	3.5 Lakhs	1993
3.	Assessment of present state of health and service suitability of turbo-generator components (Unit-I)	M/s Bokaro steel Ltd. (SAIL), Bokaro, Bihar	4.85 Lakhs	1994
4.	Assessment of metal conditions of gas turbine components by non-destructive testing (Unit-IV and VIII)	M/s Gas turbine power station, Uran (MSEB), Maharashtra	6.00 Lakhs	1994
5.	Service suitability assessment of boiler components by non-destructive testing (Unit-I and II of 35 MW set)	M/s Shriram Fertilizers and Chemicals, Kota, Rajasthan	8.35 Lakhs	1995
6.	Assessment of metal conditions of gas turbine components by non-destructive testing (Unit-II and VII)	M/s Gas turbine power station, Uran (MSEB), Maharashtra	6.00 Lakhs	1995
7.	Service suitability assessment of waste heat boiler components by non-destructive testing (Unit-VE, IIC, IVA and ID)	M/s Bokaro steel Ltd. (SAIL), Bokaro, Bihar	16.15 Lakhs	1996
8.	Assessment of metal conditions of gas turbine components by non-destructive testing (Unit-III and IV)	M/s Gas turbine power station, Uran (MSEB), Maharashtra	5.6 Lakhs	1997
9.	Assessment of service-induced damage and residual life of turbine components at STPS, Santhaldih (Unit-I)	M/s Development consultants Ltd., Kolkata	13.00 Lakhs	1998
10.	Non-destructive examinations of various boilers and turbine components by non-destructive testing (Unit-I and II of 30 MW set)	M/s Shriram Fertilizers and Chemicals, Kota, Rajasthan	6.00 Lakhs	1998
11.	Assessment of metal conditions of gas turbine components by non-destructive testing (Unit-I and V)	M/s Gas turbine power station, Uran (MSEB), Maharashtra	5.96 Lakhs	1998
12.	Residual life of estimation studies of turbine components (Unit-I and III)	M/s Chandrapura Thermal Power	4.73 Lakhs	1999

		Stations (DVC), Chandrapura, Bihar		
13.	Assessment of present state of health and service suitability of boiler components	M/s DSM Sugar Mill, Kashipur (UP)	3.25 Lakhs	1999
14.	Service suitability assessment of waste heat boiler components by non-destructive testing (Unit-IIIB)	M/s Bokaro steel Ltd. (SAIL), Bokaro, Bihar	4.9 Lakhs	1999
15.	Service suitability assessment of boiler components using non-destructive testing (Unit-II and VI)	M/s Durgapur Steel Plant (SAIL), Durgapur, WB	4.55 Lakhs	2000
16.	Assessment of present state of health and service suitability of boiler components (Unit-I and II)	M/s Dayasugar Mill, Saharanpur (UP)	6.00 Lakhs	2000
17.	Condition assessment and residual life estimation of 81.7 TPH boiler components (Unit-V and VI)	M/s Bellary Alloys and Steels Ltd., Bellary, Karnataka	8.38 Lakhs	2001
18.	Assessment of present state of health and service suitability of turbine components (Unit-II)	M/s Shriram Fertilizers and Chemicals, Kota, Rajasthan	3.75 Lakhs	2001
19.	Assessment of present state of health and service suitability of boiler components (Boiler No: GT1283)	M/s Jaypore Sugar Co., Chaggulu, AP	3.00 Lakhs	2001
20.	Condition assessment and residual life estimation of 81.7 TPH boiler components (Unit-IV and V)	M/s Bellary Alloys and Steels Ltd., Bellary, Karnataka	8.38 Lakhs	2002
21.	Assessment of present state of health and service suitability of turbine components (Unit-I)	M/s Dayasugar Mill, Saharanpur (UP)	3.25 Lakhs	2002
22.	Reviews of reports on RLA study of 2x30 MW and 3x75 MW units at DPL, Durgapur	M/s Development consultants Ltd., Kolkata	2.25 Lakhs	2003
23.	Quality evaluation of Coach wheel discs	M/s East Coast Railways, Bhubaneswar	3.00 Lakhs	2003
24.	Service suitability assessment of Coach wheel discs	M/s East Coast Railways, Bhubaneswar	3.00 Lakhs	2004
25.	Plasma processing of industrially important high temperature materials (as a member). Project duration (2002-2007)	CSIR Network Project	150.00 Lakhs	2004
26.	Assessment of present state of health of Coach Wheel discs for surface discontinuities	M/s East Coast Railways, Bhubaneswar	19.00 Lakhs	2005
27.	Developing new building construction materials and technologies (as a member). Project duration (2002-	CSIR Network Project	70.00 Lakhs	2005

	2007)			
28.	Service suitability assessment of draw gear and bogie components	M/s East Coast Railways, Bhubaneswar	22.80 Lakhs	2006
29.	Technology for assessment and refurbishment of engineering materials and components (TARE Mac). Project duration (2007-2012)	CSIR Network Project	60.00 Lakhs	2007
30.	Assessment of present state of health of draw gear components for service worthiness using non-destructive inspection	M/s East Coast Railways, Bhubaneswar	20.16 Lakhs	2008
31.	Experimental and Theoretical Investigations of the Mechanical Behavior and the Evolution of Structure for the Alloys under Non-stationary Process of Superplastic Deformation	DST, New Delhi	17.50 Lakhs	2009
32.	Investigation on isothermal and cyclic Oxidation behaviors of 2.25Cr-1Mo steel in steam environment	Institute of Climate and Energy Research, Juelich, Germany	8.55 Lakhs	2013
33.	Novel energy effective metallic materials for automotive and general engineering applications	CSIR Network Project 12 FYP	215 lakhs	2012-2017
34.	Mechanical characterization of composites through miniature specimen technique	OVGU-Magdeburg, Germany	10.65 Lakhs	2013
35.	Centre for special materials	CSIR Network Project	20 Crores	2012-2017
36	Materials Development for Restoring the Heritage Structure	CSIR Mission Projects	2 Crores	2018-2020

Highlights of my scientific contribution

My research career began in IGCAR Kalpakkam (1983) with the use of new and innovative diagnostic tool known as Acoustic Emission (AE)for understanding the oxidation endeavour of metals and alloys. This techniques provide information which are complimentary to that obtained using well established techniques normally used in oxidation studies viz. thermogravimetry, microscopy and x-ray diffraction studies. Based on our research **we were the first to establish that breakaway oxidation in metals and alloys is due to mechanical failure of the scale** which is one of the means of release of growth stresses of oxide generated as a result of conversion of metal into its oxides of various forms. Our results did not support the postulate of chemical theory as no depletion of reacting species was observed in the underlying alloys as well as no traces of their oxides was observed in the underlying matrix.

Subsequently, while working in the area of Residual Life Assessment (RLA) of Power Plant Components at CMEI Durgapur, I have correlated the steam side oxide scale thickness with Larson Miller Parameters (LMP) for low alloy steels and used these data to estimate the exhausted life fraction of super heater/ re heater tubings operating at high temperatures. **Our group was the first to use this approach to know the remnant life of high temperature tubings in Indian Thermal power Plants.** Besides improving the plant load factor (PLF) large number of power plants in our country took advantage of this approach and could avoid catastrophic failures thereby saving large nos. of human lives.

After joining IMMT Bhubaneswar in 2003, I started working on facility creation for coating development and characterization including mechanical characterization and miniature specimen testing. During this period from the government grant , I could set up following facilities:

1. Plasma Spraying system (80 kW)
2. Nano-indentation system
3. Micro scratch Tester with AE sensor
4. Instron make Universal Testing machine (100 kN and 50 kN)
5. Multi Tribotester (room temp)
6. Erosion and Abrasion tester
7. High temperature Tribotester (up to 1000 deg C)
8. Impact testing m/c
9. Indentation creep measuring system
10. Phased array ultrasonic and AE system
11. FESEM
12. Thermo gravimetric (TG) set up for oxidation studies in steam/inert atmosphere

Today, Surface Engineering Department of the institute is well equipped to use any feedstock for the development of coatings on high temperature metals and alloys and characterize them. **This is one of the best facilities for coating development and characterization in eastern part of our country. TG set for oxidation study in steam environment is unique facility in our country.** As a result of these set ups, we could establish large nos. of research collaboration with leading research labs viz. IEK Julich, Germany, OVGU Magdeburg, University of Leeds, UK and Moscow State University, Russia.

I have also taken leading role in increasing the awareness of surface science and engineering by conducting large nos. of International and national conferences and

business meet as convener for the benefit of researchers, academia and plant personals.

Thermal Barrier Coatings (TBCs) on high temperature components are essential in order to increase the steam inlet temperature of power generating units for improvement in their efficiencies. The majority of TBCs in use today are ZrO_2 based having compositions containing 7 % Y_2O_3 (7 YSZ). This coating is best suited up to $1200^\circ C$. For improved performance at higher temperatures in more severe conditions TBCs having much lower thermal conductivity and higher co-efficient of thermal expansion is desired. Hence, I have initiated a program in collaboration with HAL, Koraput for development of nano-structured TBCs doped with rare earth oxides. **In this endeavour, our group has been able to develop plasma sprayed nano-structured LaCeYSZ coatings which is nothing but 7YSZ doped with nano $La_2Ce_2O_7$.** These developed coatings has much lower thermal conductivity and diffusivity and higher thermal expansion coefficient as compared to 7 YSZ coatings. Two PhDs and 10 master students have also been guided by me in this area.

Very recently, I have moved to CSIR- CGCRI Kolkata as Head, Business Development Division, wherein apart from facilitating the commercialization of Coating and other technologies developed at laboratory scale to industries, I am also leading a program for the development of life assessment techniques for thermal barrier coatings.

In nutshell, surface science and engineering especially maneuvering surface properties for industrial application have always been the part of my long research career which began in 1983. Research domain like AE during oxidation, use of oxide scale thickness for RLA studies and development of nano structured YSZ coatings doped with rare earth oxides like $La_2Ce_2O_7$ falls in broad set of surface science and engineering, the area to which the award is bestowed. Sponsored projects in these areas have been taken to benefit the Indian industries in many ways. Our group having modern research tools as mentioned above will continue to work in these areas for inclusive and sustainable growth of our country.
