



Professor INDRANIL MANNA, *JC Bose Fellow*

FTWAS, FNA, FNAE, FNASc, FASc, MAPAM, FIE(I), FIIM, FEMSI, FAScT, DSc (hc), PRS, PhD

Vice Chancellor

Birla Institute of Technology (BIT) Mesra, Ranchi, Jharkhand 835215, India

[On lien from Metallurgical & Materials Engg. Dept., I.I.T. Kharagpur 721302, W.B.]

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President, Indian National Academy of Engineering, www.inae.in

RESUME:

Professor Manna, a JC Bose fellow of DST, is currently the Vice Chancellor of BIT Mesra, Ranchi. He obtained his B. Engg. Degree from Calcutta University (B.E. College) in 1983, M. Tech. from IIT Kanpur in 1984 and PhD from IIT Kharagpur in 1990. He was a Premchand Roychand Scholar (1992) and a Mouat Medal awardee (1999) of Calcutta University. He is an educationist and materials engineer with wide ranging research interests covering phase transformation, structure-property correlation and modeling in nanometric metals and ceramics, laser/plasma assisted surface engineering, nano/ferro-fluid and bainitic steel. His studies on amorphous Al-alloys, laser surface engineering of steel/Mg/Al alloys, boundary diffusion controlled phase transformations, and thermal/magnetic properties of nano/ferro-fluid are highly cited. He teaches subjects related to physical metallurgy and surface engineering. As a guest scientist, he visited different renowned Institutions and Universities abroad like Max Planck Institute at Stuttgart, Technical University of Clausthal, Liverpool University, Nanyang Technological University, NIMS-Japan, Unipress-Poland and University of Ulm. His research exploits have been published in over 275 peer reviewed publications; he has guided 30 doctoral theses and conducted 35 sponsored projects worth over Rs 25 crore as the PI. He is a Fellow of all the national academies of science (INSA, IASc, NASI) and engineering (INAE) in India. He was both a DAAD (1988-90) and Humboldt Fellow (2001-02) in Germany. He was honored as a distinguished alumnus by IEST Shibpur and IIT Kharagpur. He is a recipient of The World Academy of Sciences (TWAS) prize for engineering sciences (2014) and was elected a Fellow of TWAS (2015). He is also a Member of the Asia Pacific Academy of Materials. He received the MRSI Medal in 2000, Binani Gold Medal (1999) and G D Birla Gold Medal (2008) of IIM, AICTE Career Award for Young Teachers (1995), and INSA Medal for Young Scientist (1992). He was felicitated by the Ministry of Steel with the Young Metallurgist (1991), Metallurgist of the Year (2002) and National Metallurgist Award (2018). He was the National Coordinator of IMPacting Research INnovation and Technology (IMPRINT), a unique technology development initiative of MHRD during 2015-20. He is a member of the Research Boards of several industry/R&D like RINL, GAIL, BHEL, ARCI, Min of Steel and serves in several national level committees of DST, CSIR, SERB, INSA, etc. Earlier, he served as an expert in NAAC and NBA. He is a former President of the Indian Institute of Metals and Vice President of the Indian National Academy of Engineering (INAE). University of Kalyani and Kazi Nazrul University have conferred DSc (hc) on him in 2017. He served as the Director of CSIR-CGCRI in Kolkata during 2010-2012 and of IIT Kanpur during 2012-2017. Professor Manna is now the 14th President of INAE since Jan 1, 2021 for the next 2 years and is passionately involved in making INAE a national agency for promoting engineering and technological self-reliance of India by translational research and innovation.

CURRICULUM VITAE

1. Name, designation, affiliation and address:

Professor INDRANIL MANNA, JC Bose Fellow

FNAE, FNA, FNASc, FASc, FTWAS, MAPAM, FIE(I), FIIM, FEMSI, PRS, PhD, DSc (hc)

Vice Chancellor

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[on lien from: Indian Institute of Technology Kharagpur]

Email: vc@bitmesra.ac.in; imanna@metal.iitkgp.ernet.in; and im_kgp@yahoo.co.in

Personal Homepage: www.imanna.in

[**President**, Indian National Academy of Engineering, <https://inae.in/>]

2. Residential address:

VC Bungalow, BIT Mesra, Ranchi 835215, Jharkhand; and

Flat A-78, Kajubagan, IIT KHARAGPUR, W.B. 721302, INDIA

3. Date and Place of Birth: January 22, 1961; CALCUTTA (KOLKATA)

4. Religion: Hinduism

5. Nationality: Indian (Passport No.: Z 2859964)
Born in Calcutta, India

6. Family Status: Married with two children
(Spouse: Snigdha MANNA)

7. Educational Qualifications:

DEGREE/EXAMINATION (TENURE)	INSTITUTION	MAJOR	PERFORMANCE
Premchand Roychand Scholarship (PRS) (1993-1998)	CALCUTTA UNIV. Calcutta - 700 071 <i>India</i>	Applied Physics (Metallurgy)	Thesis accepted & Mouat medal awarded (1999)
Doctor of Philosophy (Ph.D.) (1986-1990)	I.I.T., KHARAGPUR W.B.-721302 <i>India</i>	Engineering	No grade is awarded
Master of Technology (M.Tech.) (1983-1984)	I.I.T., KANPUR U.P.- 208016 <i>India</i>	Physical Metallurgy	Topper Cumulative Perform. Index = 9.6/10.0

Bachelor of Engineering (B.E.) (1979-1983)	B. E. College (Calcutta University) <i>India</i>	Metallurgy	Rank - 2 nd Class - I 79% in aggregate
Higher Secondary (Class-XII) (1977-1979)	Pannalal Institution Kalyani, W.B. (under W.B.C.H.S.E.)	Science	1st Div. 69% in aggregate
Secondary Examination (Class - X) (1971-1977)	Pannalal Institution Kalyani, W.B. (under W.B.B.S.E.)	General	1st Division Rank - 43rd Star Marks 77% in aggregate

8. Professional (Administrative/Research/Teaching) Experience:

A. At Birla Institute of Technology (BIT) Mesra (2020 – present):

Vice Chancellor, BIT Mesra, Ranchi 835215, Jharkhand, INDIA (5 campuses at Ranchi, Jaipur, Noida, Patna and Deoghar)

Administrative responsibilities within BIT Mesra (ex officio):

- Member, Board of Governors and Finance Committee, BIT Mesra
- Chairman, Building & Works Committee
- Chairman, Academic Council
- Chairman, Institute Advisory, Committee and Heads' Group
- Chairman, Steering Committee of BITMAA

Academic duty/responsibility:

Professor, Department of Production and Industrial Engineering Professor

Administrative responsibilities outside BIT Mesra (National Level):

- President, Indian National Academy of Engineering (INAE)** 2021-22
- Chairman**, SERB Program Advisory Committee (PAC) of Materials-Mining-Minerals Engineering (MMME) Group (2018-present)
- Member, Governing Council, ARCI Hyderabad** (a DST Laboratory) (2018-present); and **Chairman**, Technical Advisory Group (TAG) for Centre for Laser Processing of Materials (CLPM) and Centre for Nano Materials (2017-present)
- Member, Board of Governors**, Indian Institute of Coal Management, Ranchi, Jharkhand (2021-2024).
- Member, Research Advisory Committee**, Jadavpur University (2021-present)
- Member, Academic Council, Homi Bhabha National Institute** (HBNI, under DAE), Mumbai (2018-present)
- Chairman**, INSA-Inspire Faculty Fellow Committee on Engineering (2014-2020)
- Chairman**, Research Council, CSIR-NML, Jamshedpur (2020-present)
- Member**, Sectional Committee (Engineering) of INSA-New Delhi, NASI-Allahabad, IASc-Bangalore
- Member**, Research Assessment Committee, Gas Authority of India Ltd. (GAIL), New Delhi (2015-present)

- k) **Member of the Board**, Steel Research and Technology Mission Initiative (SRTMI) 2018-present
- l) **Member**, Expert Group (EG) and Project Review Committee (PRC) of the Ministry of Steel (2020-present)

B. At IIT-Kharagpur (1985 – present; including lien during 2010-17):

- a) **Professor (HAG)**, Department of Metallurgical & Materials Engineering, I.I.T., Kharagpur – September 2009 to present [on lien between Mar 2010 to Oct 2012 (CSIR-CGCRI); Nov 2012 to Nov 2017 (IIT Kanpur) and BIT Mesra, Ranchi (Aug 2020 – present)].
Teaching, research and academic administration
- b) **INAE Visvesvarya Chair Professor**, Department of Metallurgical & Materials Engineering, I.I.T., Kharagpur and CSIR-CGCRI Kolkata – April 2009 to March 2011.
Teaching, research and academic administration
- c) **Chairman**, Central Research Facility, I.I.T., Kharagpur – Dec. 2006 to Dec 2009 and **Vice-chairman**, 2004 to 2006 (for 3 years).
Administrative position to run a central research facility that houses all the major analytical research instruments of the Institute (TEM, SEM, XRD, AES, DSC, etc.)
- d) **Professor**, Department of Metallurgical & Materials Engineering, I.I.T., Kharagpur – Jun. 2003 onwards.
Teaching in under- and post-graduate level, Independent research (Institute, Sponsored, Collaborative), Research guidance, Course-curriculum and laboratory development, Consultancy, Academic services to outside agencies, Organizing short-term courses, and Rendering administrative services
- e) **Coordinator**, Institute Mission Project on Nano Science & Technology – 2003-2009
- f) **Associate Professor**, Dept. of Metallurgical & Materials Engineering, I.I.T., Kharagpur – Mar.1997 to Jun. 2003.
Teaching in under- and post-graduate level, Independent research (Institute, Sponsored, Collaborative), Research guidance, Course-curriculum and laboratory development, Consultancy, Academic services to outside agencies, Organizing short-term courses, and Rendering administrative services.
- g) **Assistant Professor**, Dept. of Metallurgical & Materials Engineering, I.I.T., Kharagpur – Nov.1990 to Feb.1997.
Teaching in under- and post-graduate level, Independent research (Institute, Sponsored, Collaborative), Research guidance, Course-curriculum and laboratory development, Consultancy, Academic services to outside agencies.
- h) **Lecturer**, Dept. of Metallurgical Engg, I.I.T., Kharagpur - Nov. 1985 to Nov.1990.
Teaching in under/post-graduate level, Independent research (Institute/Sponsored), Research guidance (B.Tech/M.Tech), Laboratory development, etc.

Long Leave Periods:

- (a) Nov1988 to Mar1990 (MPI, Germany with DAAD Fellowship)
- (b) Jul2000 to Jun2002 (NTU Singapore for teaching; Univ Ulm as AvH Fellow)
- (c) Mar2010 to Oct 2012 (as Director, CSIR-CGCRI, Kolkata)
- (d) Nov2012 to Nov2017 (as Director, IIT Kanpur).
- (e) Aug2020 to present (as Vice Chancellor, BIT Mesra, Ranchi)

ADMINISTRATIVE POSITIONS HELD IN IIT Kharagpur:

- Acting Head, Metallurgical & Materials Engg Dept. (summer quarter, 2008)
- Chairman, Central Research Facility (2006 – 2009)
- Vice Chairman, Central Research Facility (2004-2006)
- Coordinator, Nano Science and Technology (2004 – 2010)
- Faculty adviser and Mentor to selected group of undergraduate students
- Professor-in-charge of X-ray diffraction and Heat Treatment Laboratories
- Professor-in-charge, FE-SEM and PLD laboratory (2006-2010)
- Professor-in-charge of Departmental Workshop (2004-2007)

C. Director, IIT Kanpur (7 Nov 2012 to 6 Nov 2017; 5 years)**Administrative responsibilities within IIT Kanpur (ex officio):**

- f) Member, IIT Council, Ministry of Human Resource Development, Govt of India
- g) Member, Board of Governors, IIT Kanpur
- h) Member, Finance Committee
- i) Chairman, Building & Works Committee
- j) Chairman, Academic Senate
- k) Chairman, Institute Advisory, Committee and Heads' Group
- l) Chairman, Anti Ragging Committee (statutory)

Academic duty/responsibility:

- a) Professor, Materials Science and Engineering Department (2012-17)
- b) Chairman, Academic Senate (2012-17)

Administrative responsibilities outside IIT Kanpur (ex officio):

- m) **National Coordinator**, IMPRINT India (an MHRD initiative)
- n) **Chairman, Namaste Ganga Project** (Clean Ganga Mission)
- o) **Member**, Central Advisory Board of Education (CABE), MHRD (HE) (2014 – 17)
- p) **Chairman**, Research Council, CSIR-AMPRI, Bhopal (2013-16)
- q) **Member**, Governing Body, Indo-US Science & Technology Forum (2012-17)
- r) **Member**, Executive Council, AICTE, New Delhi
- s) **Member**, Samavesh, Niti Aayog (S&T group) (2016 – present)
- t) **Member**, National Innovation Council, UP Section (2012-17)
- u) **Member**, IIM Board of Governors, Lucknow (2012-17)
- v) **Member**, IIM Society, Indore (2012-17)
- w) **Member**, Board of Governors, IIST Shibpur (2014 – present)
- x) **Member**, Board of Governors, IISER, Kolkata (2012-17)
- y) **Member**, Board of Governors, IISER, Pune and IISER, Tirupati (2012-17)
- z) **Member**, Board of Governors, MNNIT, Allahabad, U.P. (2012-17)

Responsibilities as a Peer or Domain Expert outside IIT Kanpur

- a) **President**, Indian Institute of Metals (2016-17)
- b) **Vice President**, Indian Institute of Metals (2013-16)
- c) **Member** of Board of Management of Coal India Ltd (2013-15)

- d) **Vice President**, Indian National Academy of Engineering (INAE) (Fellowship, Awards & Corporate Communication) (2014 – present)
- e) **Member** of the Research Councils of GAIL India (2013 – present)
- f) **Member**, CSIR-National Physical Laboratory in New Delhi (2010 – 2016)
- g) **Member**, Administrative Council, Abdul Kalam Tech. University, U.P. (2012-17)
- h) **Member**, Research Council, BHEL (2014 – 2017)
- i) **Member**, Research Council, Vizag Steel Plant (RINL), Visakhapatnam (2015-2018; 2019-2022)
- j) **Member**, TEQIP Board, West Bengal S&T Council for Jadavpur Univ (2014-17)
- k) **Member**, Board of Steel Research and Technology Mission Initiative (SRTMI), and Biju Patnaik National Steel Institute, Ministry of Steel, Government of India (2014 – present)

D. Director, CSIR-CGCRI (1 Mar 2010 to 31 Oct 2012)

Central Glass and Ceramic Research Institute (CGCRI), Jadavpur, Kolkata. A CSIR Laboratory (under the Ministry of Science and Technology, Government of India) – between March 1, 2010 and October 31, 2012.

Administrative responsibilities within CSIR:

- a) **Member, Governing Body and Society of CSIR** (highest body of CSIR)
- b) **Member, Planning Commission Working Group of CSIR** for 12th 5-year plan
- c) **Member, Planning Commission Working Group of DAE** (as DG-CSIR's representative) for 12th five year plan
- d) **Member, Planning Commission Working Group of DST** for 12th 5-year plan
- e) **Member, Senate, Academy of Scientific & Industrial Research (AcSIR)**
- d) **Member, Management side, Joint Consultative Mechanism, CSIR**
- e) **Member, Monitoring Committee**, NMITLI project on SOFC at CSIR-CGCRI
- f) **Chairman, Steering Committee**, NMITLI Project on SOFC at CSIR-CGCRI
- g) **Task Force Chairman**, CSIR Network Projects NWP 027, 028, 029, 035, 051
- h) **Task Force Chairman**, CSIR Supra institutional Project SIP 023
- i) **Member, Research Council** of CSIR-NML, CSIR-NPL, CSIR-CMERI, AMPRI
- j) **Member, Management Council** of CSIR-NML and CSIR-IICB
- k) **Member, Advisory Committee**, CSIR Innovation Complexes at Chennai, Mumbai, and Kolkata (Baruipur and Salt Lake)
- l) **Chairman**, CSIR-RA/SRF/JRF selection in Engineering Sciences (ENG-41)
- m) **Chairman**, Bureau of Indian Standards, Ministry of Consumer Affairs, Standards Committee on Ceramics (CHD 09) [as Director, CSIR-CGCRI]
- n) **Chairman**, Bureau of Indian Standards, Ministry of Consumer Affairs, Standards Committee on Glass and Glassware (CHD 10) [as Director, CSIR-CGCRI]

E. Academic visits abroad (on leave from IIT Kharagpur):

- a) **Visiting Professor**, Wuhan University of Science and Technology (WUT, Key Laboratory for Refractory, CHINA – Dec 2019
To teach a micro-credit course on Phase Transformation and initiate collaboration on laser surface engineering
- b) **Visiting Professor**, University of Ulm, GERMANY – June 2018 and June 2019 (1 month each)
Collaborative research for project THERMOLAB (experiments in International Space Station ISS of NASA)

- c) **Visiting Scientist**, National Institute of Materials Science, Tsukuba, Japan – May-Jun 2009
Independent research on structure of amorphous solids (~ 2 months)
- d) **Visiting Professor**, University of Ulm, GERMANY – May-July, 2007 (2 months)
Independent research on phase transformation and deformation of metallic glass
- e) **Visiting Professor**, Technical University of Clausthal. Germany – May'06 to July'06
Collaborative research on ECAP consolidation of amorphous Al alloy powders (DFG project). Also, visited/lectured at the University of Chile, Santiago (June 12-20, 2006).
- f) **Visiting Professor**, University of Tennessee, Knoxville, USA – May'05 to June'05
Collaborative research on laser surface amorphization (DST-NSF project). Also, visited and lectured at the University of British Columbia, Vancouver, Canada during July 1-9, 2005
- g) **Visiting Professor**, ENISE (National School of Engineering), Saint Etienne, FRANCE – May'04 to June'04
Independent research in surface engineering and curriculum development
- h) **Humboldt Fellow**, University of Ulm, GERMANY – Jul'01-Jun'02, Dec'02, May-Jun'03 – For independent research on Amorphous Al-alloys and Phase Transition in nanocrystalline materials under severe plastic deformation
- i) **Senior Fellow**, School of Materials Engineering, Nanyang Technological University, SINGAPORE - Jul. 2000 to Jun. 2001.
Visiting faculty position - teaching, research and administration. Entrusted to initiate a post-graduate course on thermodynamics for the first time, revise under-graduate curriculum and take up special projects.
- j) **Guest Scientist**, Max-Planck-Institut fuer Metallforschung, STUTTGART – Oct. 1999 (1 month), Jun.-Jul., 1998 (1 month), Jun.-Jul., 1997 (1 month), May-Jul., 1996 (2 months), Oct.-Nov., 1995 (2 months) – For collaborative research.
- k) **Visiting Fellow**, Laser Lab., Mechanical Engg. Dept., University of Liverpool, U.K. - May-Jun., 1999 (1 month), May-Jun., 1998 (6 weeks), Mar.-Jul. 1995 (5 months).
India-UK Collaborative Research Project; and Independent post-doctoral research as an Indian National Science Academy (INSA) - Royal Society Exchange Fellow.
- l) **Guest Scientist**, Technical Univ., CLAUSTHAL – May, 2000 (1 month), - Dec. 1999, May-Jun, 1997 – For guidance of doctoral study and collaborative research.
- m) **Guest Scientist**, Technische Universitaet, BERLIN - Dec., 1995 (1 month).
Independent research as a DAAD Re-invitation Fellow.
- n) **Guest Scientist/DAAD Fellow**, Max-Planck-Institute fuer Metallforschung, STUTTGART (1 year) - Mar.1989 to Mar.1990 (*on leave from the IIT-Kharagpur*).
Independent post-doctoral research as a DAAD Fellow.

F. Experience Prior to Joining Academic Profession in 1985:

- a) **Engineer**, Forge shop, Mishra Dhatu Nigam (A Govt. of India Integrated Superalloys plant, Ministry of Defense), HYDERABAD, A.P. India - Dec.1984 to Nov.1985 (1 year) – Supervision of the production schedule.
- b) **Teaching Assistant**, Dept. of Metallurgical Engg. I.I.T., KANPUR, India - Jan.1984 to Dec.1984 (1 year).
Rendering assistance for checking answer scripts, holding laboratory, sessional & tutorial classes, etc. (awarded to the class topper in merit list).
- c) **Vacational Trainee**, Durgapur Steel Plant, Steel Authority of India, DURGAPUR, India – May'82 to Jul.'82.

- Summer Training in an industry as a part of the undergraduate degree program.
- d) **Vacational Trainee**, Andrew Yule Co., KALYANI, W.B., India – May 1981 to Jul 1981.
Summer Training in an industry as a part of the undergraduate degree program.

9. Academic/Professional Awards and Recognition:

[A] Election to Fellowship/Membership of Scientific Peer Body/Society/Academy:

1. JC Bose Fellow, Department of Science and Technology (**DST**), Government of India, 2012-17 and 2017-present
2. Honorary Member, Indian Institute of Metals (**IIM**) awarded on Nov 14, 2017 (NMD award) as the immediate past President (2016-17)
3. Member or Fellow of The World Academy of Sciences (**TWAS**), 2016
4. Member (Fellow), Asia Pacific Academy of Materials (**APAM**), 2014
5. Fellow, Indian National Science Academy, (**INSA**), New Delhi, 2010
6. Fellow, Electron Microscopy Society of India (**EMSI**), Kolkata, 2011
7. Fellow, West Bengal Academy of Science & Technology (**WAST**), Kolkata, 2010
8. Fellow, Indian Academy of Sciences (**IAS**), Bangalore, 2008
9. Fellow, The National Academy of Sciences, India (**NASI**), Allahabad, 2005
10. Fellow, Indian National Academy of Engineering (**INAE**), New Delhi, 2005
11. Fellow, Institution of Engineers (India), (**IE(I)**) Kolkata, 2005
12. Life Fellow, Indian Institute of Metals (**IIM**), Kolkata, 2005
13. Fellow, Indian Ceramic Society (**ICS**), Kolkata, 2012
14. Member, National Academy of Sciences (**NASI**), Allahabad, India, 2003

[B] Awards, Prizes and Distinctions (National / International):

1. Conferred with **Honorary Doctor of Science** Degree by University of Kalyani, West Bengal (September 2017)
2. Awarded **MRSI Distinguished Lecture prize 2017** at the MRSI-AGM at IIT Bombay on 15.02.2017
3. Conferred with **Honorary Doctor of Science** Degree by Kazi Nazrul University, Asansol, West Bengal (January 2017)
4. **Distinguished Alumnus Award**, IIT Kharagpur, 2016 (62nd Convocation).
5. **Gopal Tripathy Memorial Lecture Award**, Banaras Hindu University (Chemical Engineering), 2015
6. **TWAS Prize for Engineering Sciences**, The World Academy of Sciences (TWAS), Trieste, 2014
7. **Distinguished Alumnus Award** from Bengal Engineering and Science University (formerly, Bengal Engineering College and presently converted to Indian Institute of Engineering Science and Technology, IIST), Shibpur, Howrah, India in Feb 2014.
8. **J C Bose Fellowship** of Department of Science & Technology, India (2012-2017).
9. **Platinum Jubilee Medal Lecture**, 98th Session of the Indian Science Congress (held in Chennai, 2011).
10. **INAE Visvesvaraya Chair Professor** (2009-2011) – Awarded by the Indian National Academy of Engineering (INAE), New Delhi.
11. **G D Birla Gold Medal**, 2008 (Awarded by the Indian Institute of Metals for outstanding contributions in Materials Science and Engineering).

12. **INAE-AICTE Distinguished Industry Professor** (2007-2009), awarded by the Indian National Academy of Engineering (INAE) jointly with Tata Steel, Jamshedpur.
13. **Metallurgist of the Year Award**, 2002 (Awarded by the Ministry of Steel and Mines, Government of India through the Indian Institute of Metals).
14. **Alexander von Humboldt Fellowship**, Germany, 2001 (Awarded by the AvH Foundation, Germany for independent research).
15. **Materials Research Society of India (MRSI) Medal**, 2000 (Awarded by the Materials Research Society of India).
16. **Binani Gold Medal, 1999** (Awarded by the Indian Institute of Metals (IIM) to the co-author of the best paper published in the Transactions of the Indian Institute of Metals in a calendar year).
17. **Mouat Medal (Calcutta University)** - 1999 (Awarded for the successful completion of the Premchand Roychand Studentship, a post-doctoral research scheme of the Calcutta University)
18. **Outstanding Referee Citation and Prize of Acta Materialia** 1999 (Awarded to 10 out of 900 referees for Acta/Scripta Materialia journals, Elsevier Science)
19. **Research Grant, GTZ-Germany 1997-1999** (Awarded by the Deutsche Gesellschaft fuer Zusammenarbeit (GTZ) GmbH).
20. **DAAD Re-Invitation Fellowship**, 1995-1996 (Awarded by the German Academic Exchange Service, Bonn, Germany).
21. **Career Award for Young Teachers**, 1995 (Awarded by the All India Council of Technical Education, New Delhi).
22. **International Exchange and Scientific Collaboration Fellowship**, 1994 (Awarded by Indian National Science Academy, New Delhi and Royal Society, London).
23. **INSA Medal for Young Scientist**, 1992 (Awarded by the Indian National Science Academy, New Delhi).
24. **Premchand Roychand Scholarship** (PRS), 1992 (Awarded by the Calcutta University for post-doctoral research).
25. **Young Metallurgist Award**, 1991 (Awarded by Ministry of Steel and Mines, Government of India through Ind. Inst. of Metals).
26. **Deutscher Akademischer Austauschdienst DAAD Fellowship**, 1988-90 (Awarded by the German Academic Exchange Service for postdoctoral research).
27. **Rai Bahadur J. N. Ghosh Memorial Scholarship**, 1986 (Awarded by the Calcutta University for higher research in overseas).
28. **National Scholarship**, 1977 (Awarded by Ministry of Culture, Government of India for Securing 43rd position in Secondary Examination among more than 120000 students in the state of West Bengal).

[C] Leader or Member of Delegation (National / International):

1. **Leader of INAE Delegation**, led a 12 member delegation of experts as the Vice President of Indian National Academy of Engineering (INAE) to **Republic of Korea** for collaboration and exchange in the 2nd thematic workshop on "*High Temperature Materials*" with the **National Academy of Engineering of Korea (NAEK)** at Changwon, Korea during May 14-15, 2018.
2. **Chairman, International Review Committee** for the Herbert Gleiter Institute at the Nanjing University of Science and Technology (NJUST), China on May 22-23, 2017
3. **Member of MHRD Delegation**, visited **Iran** during November 26-29, 2016 as part of **Directors of IITs delegation** for meeting with Heads of highly reputed Universities

and National Research Institutions in Iran for academic collaborations and agreements to promote Science and Education between Iran and India.

4. **Leader of the Delegation**, a 10 member delegation of experts from the Indian National Academy of Engineering (**INAE**) to **USA** for scientific collaboration and exchange in the area of “*Technology Domains and Grand Challenges*” with the National Academy of Engineering, Washington DC, USA during Dec 18-19, 2014.
5. **Member of CEO Delegation**, visited **Australia** during the visit of the **Hon’ble Prime Minister of India** on November 15-20, 2014. Indian Institute of Technology Kanpur and University of Melbourne agreed upon and signed a Memorandum of Understanding for collaboration in academic and research activities.
6. **Expert Member from Academia**, visited **Norway and Finland** as part of the official delegation **during the State visit of the Hon’ble President of India** from 12 October to 17 October 2014. During the visit besides various collaborative meetings various MoUs were exchanged between IIT Kanpur and various institutions of Norway and Finland. The Director, IIT Kanpur signed a Memorandum of Understanding (**MoU**) between Consortium of Finnish Higher Education Institutions, Finland and IITs, India.
7. **Leader of INSA Delegation**, a 15 member **scientific delegation** (senior and young) of the Indian National Science Academy (INSA) to **Germany** for scientific collaboration and exchange in the area of “*NanoSciences*” with the National Academy of Sciences, Leopoldina, Halle, Germany during Nov 25-26, 2013

[D] Professional Recognition, Election and Distinctions (National / International):

1. **Member, Board of Governors**, Indian Institute of Coal Management, Ranchi, Jharkhand (2021-2024).
2. **Member, Academic Council**, Homi Bhabha National Institute, **HBNI** (Deemed University) of Department of Atomic Energy (**DAE**) during 2018-present.
3. **Member, Research Advisory Committee**, Jadavpur University (2021-present).
4. **Chairman, International Review Committee** for the Herbert Gleiter Institute at the Nanjing University of Science and Technology (NJUST), China on May 22-23, 2017
5. **Chairman of the Engineering and Technology Section of the INSA INSPIRE Faculty Award Scheme of the Department of Science and Technology** (2016-present). Earlier, **Expert Member** of the Section (2014-15).
6. **Member, Research Advisory Council (RAC)** of Gas Authority of India Limited (**GAIL**) during 2014-present.
7. **Member, Research Council**, Vizag Steel Plant (RINL), Visakhapatnam (2015-2018; 2019-2022)
8. Elected **President**, Indian Institute of Metals (**IIM**) (2016)
9. Elected **Expert member** on the Governing Board of Steel Research & Technology Mission of India (**SRTMI**) constituted by **Ministry of Steel**, Government of India
10. Elected **Vice President**, Indian National Academy of Engineering (**INAE**), New Delhi, India (2015-2018).
11. Elected the **Chairman**, Metal Sciences Division and Vice President, Indian Institute of Metals (**IIM**), India (2013).
12. **Chairman**, Selection Committee of Council of Scientific and Industrial Research (CSIR) to select the research scholars (JRF/SRF/RA) in Engineering Sciences (ENG-41), 2012, 2013, 2014, 2015.

13. **Member**, Expert Committee for the special schemes of the Council of Scientific and Industrial Research (CSIR) to select projects for funding under NMITIL scheme and select companies for CSIR Foundation Day award.
14. **Member**, Research Board, H R Johnson Ltd. (Prism Cement), Mumbai, 2010-2012.
15. **Member**, Senate, West Bengal Univ of Technology, Kolkata, India, 2010-2012.
16. **External Expert**, Study Circle, Department of Metallurgical Engineering, Jadavpur University, 2010-2012.
17. **Member**, Board of Studies, Dept of Metallurgy & Materials Engineering, Bengal Engineering & Science University (BESU), Shibpore, Howrah 721103, 2010-2012.
18. **President**, Materials Science Section, 97th Indian Science Congress (held in Trivandrum, Jan. 3-7, 2010) of the Indian Science Congress Association, 2009-10.
19. **Co-Chairman**, 63rd Annual Technical Meeting of the Indian Institute of Metals (IIM) held in Science City, Kolkata during Nov 13-17, 2009.
20. **Member**, Research Council, NML, Jamshedpur (2007-2009 and 2010-2012); National Physical Laboratory (NPL) New Delhi (2010-2012, 2012-present), and Central Mechanical Engineering Research Institute (CMERI) Durgapur (2010-2012).
21. **Member**, National Organizing Committee of the Annual Technical Meeting of the Indian Institute of Metals in 2005 (Chennai), 2006 (Jamshedpur), 2007 (Mumbai), 2008 (Jamshedpur), 2009 (Kolkata), 2010 (Bangalore), 2011 (Hyderabad), 2012 (Jamshedpur), 2013 (Varanasi), and 2014 (Pune).
22. **Honorary Advisor**, DAAD (German Academic Exchange Service) 2006-2009.
23. **Member**, Program Advisory Board, NANO-2006 (An International Conference in Bangalore in Aug. 2006).
24. **Council Member**, Indian Institute of Metals for 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, 2009-10, 2010-11, 2011-12. Also, In-charge for IIM web site.
25. **International Advisory Committee Member** and Session Chair, Interfaces in Advanced Materials (IAM-03), held in Chernogolovka, Russia during May 26-30, 2003 (an international conference on interfaces).
26. **Session Chair**, Nano-2002 International Conference on Nanomaterials (Held in Orlando, USA during Jun. 16-21, 2002).
27. **Session Chair**, TMS Annual Meeting on Surface Engineering (Held in Nashville, USA during Mar. 13-16, 2000).
28. **Recorder**, Materials Science Section, I.S.C.A., 1998-99 and 1999-2000 (Elected by the Indian Science Congress Association, Calcutta).
29. **Key Note Addresses** in the 50th (1996) and 51st (1997) Annual Technical Meetings of the Indian Institute of Metals held in New Delhi and Jamshedpur.
30. **Member**, Materials Science Sectional Committee, Indian Science Congress Association (ISCA), 1997-98, 1995-96 and 1992-94 (Elected by the Indian Science Congress Association, Calcutta).
31. Institute Scheme for Innovative Research and Development (ISIRD) 1992-93 (Awarded by IIT, Kharagpur to young faculty members as research seed money).
32. Partial Travel Assistance, 1991 and 2000 (Provided by DST, AICTE and CSIR to attend International Conferences abroad).

[E] Awards / Prizes in National/International Conferences:

1. Best Paper Award at the Annual Technical Meeting of Indian Institute of Metals, 2008 [Paper: "Nano-intermetallic dispersed amorphous Al-alloy": D Roy, I Manna]
2. Best Paper Award for our work on 'Nanofluid' presented in:

- (a) International Conference on Advanced Materials Design and Development (ICAMMD-06), December 14-17, 2005, Goa, India.
- (b) International Conference on Nanoscience and Technology (ICONSAT-2006), March 16-18, 2005, New Delhi, India
- (c) National Seminar on Advanced in Nano, Metallic and Ceramic Composite, February 23-24, 2006, Trivandrum, India
3. Best Paper Award, Metallurgical & Materials Engineering Division, 18th Indian Engineering Congress, (held in Lucknow, Dec. 19, 2003) (Awarded by the Institution of Engineers (India) for the best paper in their Journal).
4. Best Paper Award, 51st Annual Technical Meeting of the I. I. M., 1997 (held at Jamshedpur) (Awarded by the Indian Institute of Metals for the best poster paper - as a co-author).

[F] Editorial and Reviewer Assignments in National/International Journals:

1. Editorial Board Member, High Temperature Materials and Processes (Editor-in-Chief: Fukuyama, Hiroyuki); Publisher: DeGruyter, Germany (2010-2017).
2. Member, Editorial Board, Indian Ceramic Society; Indian Inst of Ceramics (2012).
3. Vice President, Millennium Inst of Engg & Management, Kolkata (2011-12).
4. Associate Editor, Bulletin of Materials Science (Springer) – 2010-2012, appointed by the Indian Academy of Sciences Bangalore.
5. Editorial Board Member, Lasers in Engineering, Published by Old City Publishing Co. USA (2010).
6. Key Reader, Metallurgical and Materials Transactions A, The ASM flagship Journal, 2009-present (Appointed by the Metall. & Mater. Trans Board).
7. Member, National/International Advisory Committee, ASIA STEEL 2009 (organized by POSTECH, South Korea); MATS-2008 and ISCS-2008 (organized by Tata Steel); ICAMT-2008, ICONSAT-2008 organized by IGCAR+INAE.
8. Member, Editorial Board of STEEL TECH, a bi-monthly bulletin on Steel published by Tata Steel (2000-2008).
9. Guest Editor, Special Issue on Nanoscience and Technology, Transactions of the Indian Institute of Metals [Vol. 58(6), 2005].
10. Deputy Managing Editor, Metal News, A bi-monthly bulletin of the Indian Institute of Metals, Kolkata – 2005 to 2010.
11. Guest Editor, Special volumes on 'Surface Engineering of Steel' (2 special issues) in STEEL TECH, a quarterly journal on Steel Technology, Editor: Dr Amit Chatterjee (August and October 2008).
12. Member, Board of Editors, Computers, Materials and Continua – A new Tech Science Press international journal (ISSN 1546-2218), California, USA.
13. Member, Editorial Advisory Committee, Trans. Indian Institute of Metals, 2003-.
14. Guest Editor, Special Issue on 'Nano Science and Technology' of the Trans. Indian Institute of Metals, vol. 58(6) (2005) pp. 939-1227 (27 articles, 288 pages).
15. Reviewer, Acta/Scripta Mater, Surf Coat Technol, Appl Surf Sci, Langmuir, Mater Sci Engg A/B, Wear, Mater Chem Phy, Appl Phy Lett, J. Appl. Phy., J.Mater. Res, Philos Mag, Metall Mater Trans A, Trans Ind Inst Met, Bull Mater Sci .

[G] Contribution to National Mission Projects:

- **IMPRINT India – Round I and II:** The ambitious program of the Government of India called IMPacting Research INnovation and Technology (IMPRINT) is a first of its kind Pan-IIT + IISc joint initiative to develop a Roadmap for Research to

solve major engineering and technology challenges in selected domains needed by the country. This is a national initiative steered by MHRD to translate research and innovation in engineering and technology into viable technology through collaboration among various engineering institutions, R&D organizations, government agencies and industry. This unique initiative to address major engineering challenges faced by the nation and distributed in 10 carefully defined domain, was launched by Hon'ble President, Hon'ble Prime Minister and Hon'ble Human Resource Minister at the Rashtrapati Bhawan on 05 Nov 2015. Each of the 10 domains is coordinated by one of the IITs or IISc and **IIT Kanpur** has been vested with the responsibility of **National Coordinator**. Each domain is served by a Domain Expert Committee (DEC) who in turn report their overall progress to the National Apex Committee chaired by Secretary, Higher Education, MHRD. Detail of this initiative is available at (<http://imprint-india.org/>). In the first round of this noble initiative 259 proposals were selected after several rounds of rigorous evaluation for funding by MHRD and partner ministries out of 2612 initially submitted projects against 'National Call for Proposal' in 2016. At the moment, 142 out of 259 projects approved in principle are under progress with 50% funding from MHRD and remaining 50 % from one of the partner ministries with a total plan outlay of about Rs 400 crore in 3 years.

Subsequently, buoyed by the tremendous enthusiasm generated in academic institutions and realizing the enormous potential of this unique initiative, the 2nd version of IMPRINT, called IMPRINT II, is now under progress, which is jointly sponsored by MHRD and Department of Science and Technology (DST), steered through SERB and administered by an Apex, Steering and 10 Program Advisory Committees (PACs) with a much larger financial outlay and greater participation of industry. Currently, 475 (actually 458) final proposals shortlisted from 2145 preliminary proposals are being reviewed. Professor Manna was made the **National Coordinator** of both IMPRINT I and II (until Mar 31, 2020).

- **GIAN Initiative:** IIT Kanpur has been an active participant of the GIAN initiative (Global Initiative for Academic Networks) of Government of India with 19 approved courses. Professor Manna was responsible for administering GIAN projects at IIT Kanpur as the Director of the Institute.
- **GRBMP:** IIT Kanpur is among the consortium of 'seven Indian Institutes of Technology' formed to prepare comprehensive River Basin Management Plan for Ganga with the objectives of taking comprehensive measures for restoration of the wholesomeness of the Ganga ecosystem and improvement of its ecological health with due regard to the issue of competing water uses in the river basin. The present project named Namame Gange was administered by Professor Manna in his capacity as the National Coordinator (ex officio, Director IIT Kanpur).

[H] **Academic Distinctions in University and School:**

1. **Topper** in M.Tech. Final Exam. (1984) - I.I.T., KANPUR.
2. **2nd Topper** in B.E. Final Exam. (1983) - B.E.College (Calcutta University).
3. **43 rd Rank** in the Madhyamik Pariksha (secondary examination (class X).

10. Specialization and Major Fields of Interest:

PHYSICAL METALLURGY and MATERIALS ENGINEERING **(Phase Transformation; Microstructure-Property-Process Parameter Correlation)**

a) Surface Engineering: Laser, plasma ion implantation and electrodeposition assisted surface modification under extreme conditions of rapid thermal quenching to improve resistance to wear, corrosion and oxidation by formation of a metastable microstructure (extended solid solution/amorphous phases) and/or composition in the near-surface region, characterization by the electron-optic analytical techniques, X-ray diffraction and spectroscopy, and testing of the mechanical and electrochemical properties. Microstructural evolution in welding, cladding, rapid manufacturing and similar processing under extreme conditions. Current focus concerns development of graded microstructure, composition and functionality by laser assisted direct manufacturing of engineering components.

b) Nanocrystalline Materials: Evolution of phases including new metastable and polymorphic phases, crystal to glassy and glassy to nanocrystalline materials under non-equilibrium processing condition. Development/preparation of nanometric, intermetallic and amorphous alloys and composites by mechanical alloying and characterization of microstructure and its stability by TEM, DSC, XRD, PAS, NMR. Synthesis/characterization of nanofluid for advanced thermal engineering. Compaction/sintering by microwave and extreme pressure. Nanocrystalline hydrides for refrigeration, fuel cell and hydrogen-storage applications. Most recent

c) Mathematical Modeling: Mathematical modeling of thermal and mass transfer profile in laser material processing. Developing suitable mathematical models to correlate the microstructure/composition with properties by analytical/numerical techniques to simulate the temperature/compositional distribution profile following mechanical alloying (by high-energy ball milling), plasma ion implantation, discontinuous precipitation. Thermodynamic modeling of solid-state amorphization, metal-hydrogen equilibria, phase transition, etc.

d) Interface Diffusion and Related Phase Transitions: Determination of Arrhenius parameters of grain/interphase boundary diffusion through kinetic analysis of interface diffusion controlled phase transition like discontinuous precipitation, eutectoid reaction; and studying the concerned micro-mechanism in iso-thermal/stress/strain conditions.

e) Material Development: Developing suitable materials/processes for industrial applications (e.g. nanofluid, austempered ductile iron, graded composites). Major initiatives are under progress to develop high temperature resistant tiles and composites and understanding evolution of matter and structure/properties of solids under microgravity condition (using International Space Station platform through a European Space Agency (ESA) project).

f) **Texture:** Development of a suitable preferred orientation in polycrystalline aggregates to induce an optimum level of soft magnetic property, etc.

11. Summary of Research Output:

1. **THESIS GUIDANCE:**

<i>Ph.D</i>	= 25 (completed) + 14 (in progress)
<i>M.Tech/MS</i>	= 35 (completed) + 02 (in progress)
<i>B. Tech</i>	= 42 (completed)
2. **PUBLICATION:**

<i>Journal</i>	= 281 (Published)
<i>Conf. Proc.</i>	= 42 (Printed)
<i>Books/Journals edited</i>	= 05
<i>Chapters written in books</i>	= 11
<i>As lecture notes in short term course</i>	= 24
<i>Invited papers (presentation only)</i>	= 67 + 44 = 111
<i>In seminar/symp./conf. (abstracts)</i>	= 116
3. **CITATION RECORD:**

SCOPUS: Articles = 282, Citation = 8457 by 6727 documents; *h* index = 46;
Average citation per article > 30

WEB OF SCIENCE: Articles = 299, Citation = 7783 by 6191 documents;
h index = 45; Average citation per article > 26

GOOGLE SCHOLAR: Citation = 11159 (total) and 5602 (since 2016)
h index = 52 (overall) and 38 (since 2016)
i10-index = 184 (overall) and 107 (since 2016)
4. **PATENT:** = 1 (granted) + 2 (filed)
5. **SPONSORED PROJECTS** (as PI/Co-PI):
 - (i) 39 worth over **Rs. 170 million** (only at IIT Kharagpur during 1990-2009)
 - (ii) Four (4) on-going since Jan 2018 worth > **Rs 80 million**

12. Most Significant Scientific (Research) Contributions:

Prof. Manna's research endeavors concern the broad area of **phase transformation and structure-property correlation in engineering materials including nanometric solids (metallic/ceramic) and nanofluids, surface engineered metallic and ceramic systems including steel, composites and coatings**. The most significant contributions made by him in this direction are summarized below.

1. On Nanostructured and Amorphous Materials:

Prof. Manna's interest lies in **synthesis, phase transformation, properties and application of nano-structured materials** prepared by mechanical alloying/milling. The major contributions:

- **Al-alloy composites:** Developed a new series of Al-based simple ternary **Al-Cu-TM/Al-TM-Si** alloys (TM = early transition metals = Ti, Nb, Zr) by mechanical alloying amenable to forming **an amorphous phase dispersion in nanocrystalline matrix, or nano-intermetallic dispersion in amorphous or nanocrystalline matrix** either during controlled milling or subsequent annealing. A number of other Al-based composites (AlNiTi, ACuCr and Al + stainless steel) have also been developed. A **patent** has recently been granted on the **Al-Cu-Ti** system. Recently, utilized ball milling to develop ultrafine fly ash for structural application.

- **Nanofluid:** Developed **nanofluid** (stable colloidal dispersion of nanometric metallic (Al-alloy) or ceramic (zirconia/titania) particles (< 1 vol.%) in water or ethylene glycol) by single- or two-step synthesis process and obtained **50-100% increase in thermal conductivity ratio**, ideal for advanced heat transfer applications. Also, investigated role of aspect ratio, volume percent size and chemistry of nanoparticles on conductivity ratio.
- **Size-dependent polymorphism:** Discovered **bcc→fcc** (in Nb) and **hcp→fcc** (in Zr, Ti) **polymorphic transformation** in early transition metals during mechanical attrition due to **nanocrystallization and high degree plastic strain/strain-rate**. Also, proposed a thermodynamic model based on isothermal equation of state to explain the genesis of such transformation upon nanocrystallization and proved that the said change is not impurity driven and could be reversible. Similar transformation has since been report in other ceramic and metallic alloys.
- **Functional nanomaterials:** Synthesized **nanocrystalline superparamagnetic** ($H_c < 1$ Oe) Mn-Zn spinel-ferrites, nano-oxides for memory devices, electrolytes in solid oxide fuel cell, polymers for photovoltaic packaging and most recently, ZnO+SnO₂ hybrid with varying size, shape and morphology for gas sensors.
- **Synthesis of nanoalloys:** Developed several **nanocrystalline aluminides** (Nb-Al, Cu-Al, Ni-Al) and **γ-brass** at room temperature with *metastable* microstructure or composition from elemental powder blend by mechanical alloying.

2. On Surface Engineering:

Dr. Manna has made a number of noteworthy contributions in the area of laser or plasma assisted surface engineering to enhance surface dependent properties like wear, corrosion and oxidation resistance of metallic systems.

- (a) **Laser Surface Engineering (LSE):** Majority of these efforts were based on various innovations and strategies based on laser surface alloying (LSA), cladding (LSC), melting (LSM), hardening (LSH) or composite surfacing (LCS) of different ferrous and non-ferrous metallic metals/alloys:
- Explored developing Fe-Cr-Mo-Y-B-C **amorphous/glassy coating on steel substrate** to enhance wear resistance and investigated the role of substrate in heterogeneous nucleation or epitaxial growth.
 - Improved **oxidation and wear resistance of Ti** by laser surface alloying (LSA) with Si, Al or Si+Al forming Ti₅Si₃-rich layer and established the concerned **mechanism and kinetics** of oxidation and wear resistance due to Ti₅Si₃-rich layer.
 - Developed a new strategy of **laser assisted composite surfacing (LCS)** (compositional grading of surfaces with varying degree of dispersion) to significantly enhance wear resistance of components based on **Al/Al-alloys, Cu/Cu-alloys, Mg-alloys** and **mild/stainless steel**.
 - Enhanced **wear and erosion resistance** (both at room/high temperature) of Cu by LSA with Cr by solid solution and dispersion hardening. A process map on variation of surface microstructure, composition and hardness as a function of laser parameters has been established.
 - Improved **corrosion and wear resistance of Mg-alloys** by laser surface melting (LSM), LSA with Al+Mn or thermal oxidation, and studied the defect structure and its influence on corrosion and wear resistance.
 - Enhanced **oxidation resistance of 2.25Cr-1Mo ferritic stainless steel** by LSA with Cr, **inimonic superalloy with Si+Al** and **pitting and general corrosion resistance and wear resistance** of AISI 304/316 austenitic stainless steel by LSA with Mo.

- Developed high specific surface area **neural stimulation electrode material** by LSA of Ti with Ir and mimic the spatio-temporal profile of neuronal activation to cure neuronal disorders (like tinnitus, cardio-vascular stimulation, etc.).
- Demonstrated *for the first time* that **laser surface hardening (LSH)** is more appropriate for enhancing wear and fatigue resistance of austempered ductile iron than that by LSA or laser surface melting due to a residual compressive stress on the surface.
- Proved that **LSH of plain carbon and ball bearing steel** could provide equivalent hardening of surfaces as that in bulk hardening operations.
- Explored **laser assisted deposition of Co, surface melting, oxidation or laser nitriding** of Ti6Al4V based bio-implants for developing prosthesis with enhanced surface functionality.
- Published several **invited review** articles on different aspects of LSE.

(b) Plasma Surface Engineering (PSE):

- Enhanced wear and corrosion resistance of ball bearing steel by different surface engineering approaches (gas and plasma nitriding, plasma ion implantation) to enhance hardness and corrosion resistance of stainless and ball bearing steel. Prof. Manna installed a plasma-immersion-ion-implantation (PIII) facility in 2000 with a DST project, which has now been upgraded to an indigenously designed/developed plasma assisted implantation and deposition (PAID) unit (**a new hybrid deposition and implantation technology**) through another DST funding in 2005. This is the first university based PIII/PAID laboratory in India (for metallic/ceramic components).

(c) Supplementary Studies on Surface Engineering:

- Earlier Prof. Manna developed a novel technique of **enhancing diffusion coating kinetics** by increasing specific boundary area on surface through controlled surface deformation and diffusion annealing. A similar method, called SMAT, has now been commercialized.
- Developed a **co-deposition technique** to apply nano-aluminides on surfaces of copper to enhance wear resistance without deteriorating electrical conductivity. This is the first time that co-deposition of nano-aluminide/intermetallic has been possible.
- Achieved **laser assisted bending** of stainless steel (for automobiles) and **laser assisted fabrication** of stainless steel.
- Initiated a new program on **laser assisted transmission lap welding** (transparent sheet on translucent substrate) of polymeric sheets.
- Initiated a program on **electron beam assisted welding** of dissimilar nuclear grade metals/alloys (Nb, Zr alloys, stainless steel, Cu), and thermal spray deposition on steel.
- A new initiative is being undertaken to develop **plasma assisted jet vapor deposition (PEJVD)** as a new Zn-free coating technology for steel in collaboration with Tata Steel and FCIPT-Gandhinagar.

3. On Moving Boundary (Discontinuous or Invariant) Reactions:

Prof. Manna has made a commendable contribution in furthering the knowledge concerning discontinuous reactions, particularly, discontinuous precipitation (DP) and coarsening (DC) including publishing three review articles and numerous papers in specific areas of mechanism and kinetics like:

- Reported **occurrence of DP/DC** in several new binary systems *for the first time*: Cd-Ag, Zn-Al, Zn-Ag, Zn-Cu.
- Established that the **dynamic properties** (diffusivity, mobility, etc.) of the grain vis-à-vis interphase boundaries are comparable in moving boundary reactions and proved that grain boundaries undergo no structural transformation to attain mobility from static

condition in moving boundary reaction (hence static/dynamic boundaries have same structure). In this regard, a **generalized criterion** for selection of the initiation sites for DP and DC from among different types of natural and/or synthetic grain and phase boundaries, including the necessity or otherwise of maintaining Livingston-Cahn relation was proposed. Indeed, it was shown that initiation of DP is feasible from interphase boundaries and a **new mechanism** of DP initiation from interphase boundaries was formulated *for the first time*

- Proposed a new **resistometric method** of determining **metastable solvus** for DP], and detecting a **clustering reaction** (D_v -controlled) preceding DP in Pb-Sn for the first time.
- Developed a novel technique of **determining the Arrhenius parameters of boundary diffusion** through kinetic analysis of DP and DC. Utilizing this, he has determined boundary diffusivity through kinetic analysis in many systems in which reliable data on the same were not available. This approach is proven applicable in principle to all moving boundary reactions.
- Resolved the controversy about the effect of ternary addition on DP kinetics and proving that '**solute drag**' exerted by the ternary atoms, neither atomic size difference nor valence electron difference constitutes the main mechanism of retarding the DP kinetics.
- Reported that **volume diffusion controlled metastable decomposition** (say, clustering) precedes boundary diffusion controlled eutectoid reaction in Cu-In or DP in Zn-Al or Pb-Sn *for the first time*.

4. On Mathematical/Thermodynamic Modeling:

Prof. Manna has utilized mathematical modeling as a tool for investigating the mechanism and simulating the kinetics of several phase transitions.

- **Moving Boundary Phase Transition:** Contributed significantly towards **developing analytical/numerical models of peritectic and peritectoid** transformation kinetics that showed better insight into the transformation mechanism and better agreement with experimental data.
- **Synthesis and Properties of Nanostructured Materials:** Proposed a **numerical model of mechanical alloying kinetics** capable of considering the concentration dependent diffusivity, interface shift, and introducing the idea of an '*effective temperature*' of diffusion in mechanical alloying *for the first time*. Correlated the **excess free volume or volume per atom in nanocrystals with grain size** and accounted for the "*inverse Hall-Petch*" relation, "*enhanced diffusivity*" and "*polymorphism*" in terms of negative hydrostatic pressure generated due to nanocrystallization (crystallite size reduction beyond a critical level). Proposed a **mathematical model of milling dynamics** to predict the optimum conditions of mechanical alloying to develop nanocrystalline alloys.
- **Heat Transfer in LSE:** Developed transient or steady state models of LSA (under pre-deposition scheme) based on explicit finite difference technique to predict the temperature profile, thermal history and microstructure of the alloyed zone. This has been the maiden effort to model LSH or LSA involving transient melting and solidification of a bi-metallic layer. A similar model is applied to model the effect of laser assisted austenitizing on degree/uniformity of martensitic change in LSH by self-quenching.
- **DP Kinetics:** Modified the Cahn's equation to **analytically predict the solute distribution profile** in solute depleted matrix behind the reaction front in DP that shows excellent agreement with experimental data.

- **Frictional Heating:** Modeled the heat transfer process during a pin-on-disc wear-testing operation to demonstrate that accumulation of frictional heat may irreversibly degrade the microstructure.
- **Solid State Amorphization:** Applied empirical thermodynamic model of Miedema to predict phase evolution including the genesis of solid state amorphization in mechanically alloyed Al-alloys.
- **Austempering:** Analyzed heat transfer in engineering components of complex shape during austempering by finite element modeling.

5. Physical Metallurgy of Steel and Cast Iron:

- Studied microstructural stability of FeCrB or FeCrNiCoB glassy alloys subjected to simulated high strain rate deformation (milling).
- Developed bainitic microstructure in SAE 52100 steel in order to explore the possibility of developing tougher bearing material by austempering instead of conventional practice of achieving tempered martensitic microstructure by hardening and tempering.
- Proposed an innovative combination of creating martensitic surface by laser surface hardening on bainitic core (developed by austempering) in SAE 52100 steel for bearing applications].
- Modeled the heat transfer condition of austenitizing and austempering of spheroidal graphitic iron to optimize bainitic transformation and microstructure.
- Studied the effect of environment on fatigue strength (crack growth retardation) of HSLA 80A steel and effect of thermal cycling on Fe-Ni-Mn maraging steel.

6. On Texture:

Dr. Manna developed an optimum routine of cold rolling followed by recrystallization and magnetic annealing for two indigenously developed **Ti and Ti+Cr added soft magnetic Ni-Fe-Cu permalloys** and correlated the microstructural evolution with texture/process parameters. He has recently utilized texture analysis to throw new insight into improvement in wear resistance of SAE 52100 steel by gas nitriding.

13. Sponsored Research Schemes (at IIT Kharagpur):

[A] CURRENT:

1. **Development of Microstructurally, Compositionally and Functionally Graded Components by Laser Assisted Materials Processing (LAMP) (Code: DGL)**
(Principal Investigator)
Sponsor: Department of Science and Technology, New Delhi
Duration: 3 years
Fund: Rs. 60.16 million (approx.)
Status: Commenced in July 2018
2. **Development of novel multi-oxide in-situ thermal barrier coating for high temperature oxidation resistance using thermal spray and self-propagating high-temperature synthesis (SHS) technique (Code: ONC)**
(Principal Investigator)
Sponsor: Indian Space Research Organization (ISRO) and KCSTC, IIT, Kharagpur
Duration: 2 years
Fund: Rs. 1.9 million (approx.)

Status: Commenced in July 2018

3. **Development of nanostructured CONiCrAlY bond coat by HVOF spraying for thermal barrier coating applications (Code: NCH)**

(Co-Principal Investigator)

Sponsor: Indian Space Research Organization (ISRO) and KCSTC, IIT, Kharagpur

Duration: 3 years

Fund: Rs. 2.9 million (approx.)

Status: Commenced in August 2018

4. **J C Bose Fellowship (20112-2017; 2017-2022) (Code: JCP)**

(Principal Investigator)

Sponsor: Department of Science & Technology (DST), New Delhi

Duration: 5 years (2nd phase, 2016-2021)

Fund: Rs. 9.5 million (approx.)

Status: Commenced in July 2017

[B] COMPLETED before lien to CSIR-CGCRI and IIT Kanpur:

1. **Development, synthesis, characterization and thermo-physical property measurement of ceramic nanoparticle dispersed nanofluids for thermal applications (OLP 280)**

(Principal Investigator)

Sponsor: Council of Scientific & Industrial Research (CSIR), New Delhi

Duration: 3 years

Fund: Rs. 0.52 million (approx.)

Status: Commenced on October 2010 (at CSIR-CGCRI).

2. **Euro-Indo forum for nano-materials research coordination & cooperation of researchers in sustainable energy technologies (RST)**

(Co-Principal Investigator)

Sponsor: European Union FP 7) Code name: e-ICOON, Grant agreement no.: 233466

Duration: 4 years

Fund: Rs. 741,428.00 (1st Installment)

Status: Commenced in March, 2011.

3. **INAE Visvesvarya Chair Professorship (code: VVC)**

(Principal Investigator)

Sponsor: Indian National Academy of Engineering (INAE), New Delhi

Duration: 2 years

Fund: Rs. 1.83 million (approx.)

Status: April 2009 to March 2011.

4. **Grain Boundary Segregation, Precipitate Morphology and Surface Modification in case of Complete and Incomplete Grain Boundary Wetting by a Second Solid Phase in Steels (code: GBS)**

(Principal Investigator)

Sponsor: Department of Science and Technology (Indo-Russian Collaborative Research Project, RFBR)

Duration: 2 years

Fund: Rs. 1.3 million (approx.)

Status: Commenced on March, 2009.

5. **Nano-fluid Based Coolant and Combustion Fuel System (Code: NBS)**
(Principal Investigator)
Sponsor: Indian Space Research Organization (ISRO) and KCSTC, IIT, Kharagpur
Duration: 1 year
Fund: Rs. 0.5 million (approx.)
Status: Commenced on April 2009.
6. **Versatile nano-zirconia for Indian rare Earth Limited, OSCOM (Code: VNZ)**
(Co-principal Investigator)
Sponsor: Indian Rare Earth Limited, Research Center, Kollam, Kerala
Duration: 3 years
Fund: Rs. 4.5 million (approx.)
Status: Commenced on June 2008.
7. **Development and Characterization of Nano-fluid for Heat-Transfer Applications in Nuclear Power Plants (code: NPP)**
(Principal Investigator)
Sponsor: Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam
Duration: 2 years
Fund: Rs. 1.9 million (approx.)
Status: Commenced on May 2008.
8. **Development and characterization of copper based brazing alloy by rapid solidification and mechanical alloying (code: RSM)**
(Principal Investigator)
Sponsor: Indian Space Research Organization (ISRO) and KCSTC, IIT, Kharagpur
Duration: 1 year
Fund: Rs. 0.4 million (approx.)
Status: Commenced on April 2007.
9. **Development of Compositionally and Microstructurally Graded Thermal Barrier Coating by Plasma Spraying**
(Co-Principal Investigator; PI: Dr. J. Dutta Majumdar)
Sponsor: Department of Science and Technology, New Delhi
Duration: 3 years
Fund: Rs. 3.5 million (approx)
Status: Approved, to begin shortly after the funds are transferred.
10. **Development and characterization of Nanostructured Thin Films for SiGe Quantum Well Infrared Photodetector (QWIP) and Ferroelectric based Gas/Chemical Sensors (code: FIR)**
(Principal Co-investigator; PI: Prof S K Ray)
Sponsor: Defense Research and development Organization (DRDO), New Delhi
Duration: 5 years
Fund: Rs. 20.02 million
Status: Commenced on Aug. 2007.
11. **Establishment of an Advanced Research Facility for EB Welding and Process Development Related to Programs of Interest to DAE (code: EBW)**
Sponsor: Board of Research in Nuclear Sciences (BRNS) and Dept. of Atomic Energy, Gol
Duration: 3 years
Fund: Rs. 13.3 million (Rs 4.3 m from BRNS + Rs 9 m from DAE)
Status: Commenced on Mar 2007.

12. **Development of multifunctional surface on Ti and its alloys for tailoring wear resistance and biocompatibility (code: TWR)**
(Co-principal Investigator, PI: Prof J Dutta Majumdar)
Sponsor: Council of Scientific & Industrial Research (CSIR), New Delhi
Duration: 2 years
Fund: Rs. 1 million (approx.)
Status: Commenced on May 2007.
13. **Development of nanocrystalline coating by combined plasma assisted implantation and deposition (code: PAI)**
(Principal Investigator)
Sponsor: Deptt. of Science & Technology (DST), New Delhi
Duration: 3 years
Fund: Rs. 5.3 million
Status: Commenced on Mar 2006.
14. **Synthesis and Characterization of Nanostructured Materials for Functional and Structural Applications (code: SCM)**
(Principal Investigator)
Sponsor: Deptt. of Science & Technology (DST), New Delhi under Nanomaterials Science and Technology Initiative (NSTI)
Duration: 5 years
Fund: Rs. 28 million
Status: Commenced on Mar 2006.
15. **Surface Engineering of Ball Bearing Steel by Plasma Immersion Ion Implantation (code: SPI)**
(Principal Investigator)
Sponsor: TATA STEEL, Jamshedpur
Duration: 2 years
Fund: Rs. 1 million (approx.)
Status: Commenced on Aug., 2003.
16. **Laser Assisted Manufacturing of Compositionally Graded Coating and Drilling of Metals and Alloys**
(Co-Principal Investigator)
Sponsor: Council of Scientific & Industrial Research (CSIR), N. Delhi
Duration: 3 years
Fund: Rs. 1.3 million (approx.)
Status: Commenced on Mar. 2003.
17. **Laser Assisted Fabrication of Functionally Graded Component for Hip Joint and Femoral Replacement**
(Co-Principal Investigator)
Sponsor: BRNS, Department of Atomic Energy
Duration: 3 years
Fund: Rs. 1.6 million (approx.)
Status: Commenced on Aug. 2003.
18. **Thermal Performance of Nanofluid Based Cooling Systems (code: NBC)**
(Principal Investigator)
Sponsor: Delphi Automotives Systems, Pvt. Ltd., Bangalore
Duration: 6 months
Fund: Rs. 0.1 million (approx.)
Status: Completed in July 2008.

19. **Development and Characterization of Novel Nanocrystalline Metallic/Ceramic Based Hydrogen Sensor Materials (code: NNM)**
(Principal Investigator)
Sponsor: Ministry of Human Resource Development (MHRD) – R&D projects
Duration: 3 years
Fund: Rs. 1.5 million
Status: Completed in May 2008.
20. **Synthesis and Characterization of Al-based Nanocrystalline Composites (code: ANC)**
(Principal Investigator) – Indo-Polish Collaborative Project
Sponsor: Deptt. of Science & Technology (DST), New Delhi and Komitet Badań Naukowych (KBN), Poland under Scientific and Technological International Cooperation Joint Project for the years 2004-2006
Duration: 2 years
Fund: International travel and contingency, Rs. 0.3 million
Status: Completed in July 2007.
21. **Development of Wear-resistant Cu-alloy with Nanocrystalline Ceramic Phase Dispersion by Mechanical Alloying for Electrical Contacts/Components (code: DWR)**
(Principal Investigator)
An International Project Award (selected from 145 proposals from 27 countries)
Sponsor: International Copper Association, USA
Duration: 1 year
Fund: USD 22000.00
Status: Completed in Mar 2006.
22. **Production of porous TiNi shape memory alloys from mechanically alloyed powders for biomedical applications – A Fast Track Research Scheme for Dr B B Panigrahi**
(Principal Investigator)
Sponsor: Deptt. of Science & Technology (DST), New Delhi
Duration: 2 year
Fund: Rs. 1 million (approx.)
Status: Completed in December 2006.
23. **Development and Characterization of Nano-fluid for Micro-thermal Heat Transfer Applications in Advanced Satellite (code: DCN)**
(Principal Investigator)
Sponsor: Indian Space Research Organization (ISRO) and KCSTC, IIT, Kharagpur
Duration: 2 years
Fund: Rs. 0.5 million (approx.)
Status: Completed in August 2006.
24. **Synthesis and characterization of nanocrystalline ZrO₂-based electrolyte for solid oxide fuel cells (code: SOF)**
(Principal Investigator)
Sponsor: Council of Scientific & Industrial Research (CSIR), New Delhi
Duration: 3 years
Fund: Rs. 1.1 million (approx.)
Status: Completed in April 2007.
25. **High Speed Laser Synthesis of Amorphous Surface Structure (code: LSH)**

- (Principal Investigator)
Sponsor: Deptt. of Science & Technology (DST), New Delhi and National Science Foundation (NSF), USA
Duration: 3 years
Fund: Rs. 1.7 million (approx.)
Status: Completed in March 2007.
26. **Development of Al-based Nanocrystalline and Amorphous Alloys by Mechanical Alloying (code: AMA)**
(Principal Investigator)
Sponsor: Council of Scientific & Industrial Research (CSIR), New Delhi
Duration: 3 years
Fund: Rs. 1.7 million (approx.)
Status: Completed in Aug. 2007.
27. **Compressor Driven Metal Hydride Cooling and Heating Systems**
(Co-Principal Investigator)
Sponsor: Ministry of Non-Conventional Energy Sources, New Delhi
Duration: 3 year
Fund: Rs. 1.7 million (approx.)
Status: Completed in Dec. 2004.
28. **Plasma Based Ion Implantation for Surface Engineering of Titanium Alloys to Improve Wear and Oxidation Resistance**
(Principal Investigator)
Sponsor: Dept. of Science & Technology (DST), Govt of India (under CDPS program)
Duration: 3 years
Fund: Rs. 5.2 million (approx.)
Status: Completed in Dec 2003.
29. **Laser Surface Engineering of Magnesium and Its Alloys to Enhance Wear and Oxidation Resistance**
(Principal Investigator)
Sponsor: DST-DAAD Exchange Research Fund.
Duration: 2 years
Fund: Rs. 0.4 million and DM 4000.00 (approx.)
Status: Completed in Dec. 2001.
30. **Laser Surface Engineering for Enhanced Abrasion and Impact-Fatigue resistance of Excavator Components**
(Principal Investigator)
Sponsor: UK-INDIA Science and Technology Research Fund.
Duration: 2 years
Fund: Rs. 0.5 million and UKP 5000.00 (approx.)
Status: Completed in Dec. 2000.
31. **Laser Surface Engineering of Commercial Metals for Improved Corrosion and Oxidation Resistance**
(Principal Investigator)
Sponsor: Min. of Human Resource Development (MHRD), N. Delhi.
Duration: 3 years
Fund: Rs. 0.8 million (approx.)
Status: Completed in Mar. 2000.

32. **Development of Superior Corrosion and Oxidation Resistant Materials for Fast Breeder Reactors by Laser Surface Engineering**
(Principal Investigator)
Sponsor: Coun. of Sci. & Indus. Res. (CSIR), N. Delhi
Duration: 4 years
Fund: Rs. 0.6 million (approx.)
Status: Completed in Mar. 2000.
33. **Improvement in Oxidation Resistance of Nimonic Alloys By Laser Surface Engineering**
(Principal Investigator)
Sponsor: All India Council of Technical Education (AICTE), N. Delhi
Duration: 4 years
Fund: Rs. 0.6 million (approx.)
Status: Completed in Mar. 1999.
34. **Development of High Temperature Resistant Materials By Laser Surface Engineering**
(Principal Investigator)
Sponsor: All India Council of Technical Education, N. Delhi
Duration: 3 years
Fund: Rs. 0.2 million + Personal Salary for 3 years
Status: Completed in Sept. 1998.
35. **Measurement of Grain Boundary Diffusivity Through Kinetic Analysis of Discontinuous Precipitation - A Novel Technique**
(Principal Investigator)
Sponsor: Coun. of Sci. & Indus. Res. (CSIR), N. Delhi
Duration: 3 years
Fund: Rs. 0.5 million (approx.)
Status: Completed in Mar. 1996.
36. **Development of Nanocrystalline Composites by Mechanical Alloying & Characterization**
(Co-Investigator with Prof. S. K. Pabi)
Sponsor: Deptt. of Science & Technology (DST), Govt. of India
Duration: 3 years
Fund: Rs. 3 million (approx.)
Status: Completed in May 1998.
37. **Investigation into Solidification Behaviour, Thermophysical Characteristics and Mechanical Properties of Composites**
(Co-Investigator with Profs. B. K. Dhindaw & S. C. Panigrahi)
Sponsor: All India Council of Technical Education (AICTE), N. Delhi
Duration: 3 years
Fund: Rs. 0.5 million (approx.)
Status: Completed in Mar. 1995.
38. **Development of Superior Corrosion and Oxidation Resistant Materials By Laser Surface Treatment**
(Investigator-in-Charge)
Sponsor: Indian National Science Academy (INSA), New Delhi
Duration: 3 years
Fund: Rs. 0.1 million (approx.);
Status: Completed in Nov. '95.

39. **Development of Wear and Corrosion Resistant Materials Through Laser Surface Alloying** (*Investigator-in-Charge*)
Sponsor: *Inst. Scheme for Innovation Res. & Dev., I.I.T., Kharagpur*
Duration: 1 year; Fund: Rs. 25 k (approx.); Status: Completed in Mar. '94.

Recent Industrial Consultancy

- ❑ **Failure analysis of failed sucker rods in petroleum pipeline** (Lonestar Alpha Laboratories, Dubai)
- ❑ **Plate cooling efficiency of nanofluid for automobiles** (DELPHI, Bangalore)
- ❑ **Characterization of spinel content in Mn-Zn ferrites** (EPCOS Ferrites, Kolkata)
- ❑ **XRD analysis of sinter products and welded joints** (Tata Steel, Jamshedpur)
- ❑ **Phase analysis of bearing steel** (Bearings Division, Tata Steel, Kharagpur)
- ❑ **Structural characterization of nanomaterials** (Vidyasagar University)
- ❑ **Volume fraction of phases** (National Metallurgical Lab., Jamshedpur)

14. Teaching Experience and Contributions:

(a) Details of Courses Taught at BIT Mesra (2020-present):

Sl.	Subject	Number	L-T-P	Level
1.	Metallurgy	PE 201	3-0-0	2nd year Production Engineering BTech
2.	Surface Engineering	PE 324	3-0-0	3rd + 4th Year BTech Mech + Prod Engg
3.	Metallurgical & Materials Engineering	PE 214	3-0-0	2nd Year BTech Mech + Prod Engg

(b) Details of Courses Taught at IIT Kanpur (2012-2017):

Sl.	Subject	Number	L-T-P	Level
1.	Phase Transformation	MSE 301	2-0-0	3rd year MSE BTech + Integrated M Tech
2.	Structure and Characterization of Materials	MSE 203	3-0-0	2nd year MSE BTech + Integrated M Tech
3.	Surface Engineering	MSE 675		M. Tech + B. Tech
4.	Heat Treatment & Surface Hardening	MSE 671A		M. Tech+B. Tech

Short Term Courses offered at IIT Kanpur:

- Taken short courses on **PGPEX-VLM**, a Post Graduate Program for Executives for Visionary Leadership in Manufacturing (VLFM), 2013, 2014, 2015, 2016. This one year full time residential program has a built in manufacturing focus that helps to follow

an industry's metamorphosis in competitive times. The course is conducted jointly by 3 premier institutes in India, namely, IIM Calcutta, IIT Kanpur and IIT Madras.

(c) Details of Courses Taught at IIT Kharagpur (1985-2010, 2017-20):

Sl.	Subject	Number	L-T-P	Level
1.	Phase Transformation & Phase Equilibrium	MT31003	3-1-0	3 rd year MME B Tech + Integrated M Tech
2.	Phase Transformation & Heat Treatment (Theory and Laboratory)	MT34005	3-1-3	3 rd year MME B Tech + Integrated M Tech
3.	Phase Transformation	MT60028	3-1-0	1 st year MME M Tech
4.	Phase Transformation Laboratory	MT69008	0-0-3	1 st year MME M Tech
5.	Kinetics of Metallurgical Processes	276002	3-1-0	1 st year MME M Tech
6.	Surface Engineering*	274018	3-0-0	4 th year MME B Tech
7.	Introduction to Materials (Theory)*	272001	3-1-0	2 nd year MME B Tech
8.	Introduction to Materials (Lab.)	272901	0-0-3	2 nd year MME B Tech
9.	X-ray Diffraction (Theory)	273006	3-1-0	3 rd year MME B Tech
10.	X-ray Diffraction (Lab.)	MT33106	0-0-3	4 th year MME B Tech
11.	Advanced Thermodynamics	27601	3-1-0	1 st year MME M Tech
12.	Materials Characterization (partly)	27422	3-0-0	4 th year MME B Tech
13.	Engineering Metallurgy (Theory)	27202	3-1-0	Non-dept. 2 nd year B Tech
14.	Engineering Metallurgy (Lab.)	27292	0-0-3	Non-dept. 2 nd year B Tech
15.	Engineering Materials (Theory)	27421	3-0-0	Non-dept. 4 th year B Tech
16.	M. Tech Seminar	27604	0-0-3	2 nd year MME M Tech

(*introduced **for the first time** at the IIT, Kharagpur; MME = Metall. & Mater. Engg. Dept.)

Teaching Assignments at Nanyang Technological University, Singapore (2000-2001):

1. Material Structure and Mechanical Behavior (theory) - 4 credit UG course.
2. Thermodynamics of Solids (theory) - 4 credit (PG) course - introduced first time in School of Materials Engineering, Nanyang Technological University (NTU).
3. Properties of steel (experiment) - UG laboratory.

Short Term Courses or Lectures offered to the Industry:

1. Hindustan Aeronautics Limited (HAL), Bangalore – Spring-2006, Autumn-2006, Spring-2007, Autumn-2007
2. Hindustan Zinc Limited, Udaipur – Autumn 2005
3. Tata Steel and Tata Motors, Jamshedpur – April, May, 2005 and September 2006

15. Professional/Administrative Service to other Institutions:

1. Editorial Board Member, Lasers in Engineering, Old City Publishing Co, USA (2010-present).
2. Editorial Board Member, High Temperature Materials and Processes, Publisher: DeGruyter, Germany www.degruyter.com/page/flavor (2009-now).

3. Appointed DAAD Honorary Adviser for Indian students willing to pursue higher studies in Germany (by German Academic Exchange Service) 2006-2009.
4. Served as a member of the Advisory Committee of international conferences and symposia namely, MATS-2008 and ISCS-2008 (organized by Tata Steel in Feb. 2008), ICMAT-2008 (organized by IGCAR+INAE in Mar. 2008).
5. Appointed a member of the Research Council (highest administrative and advisory body) of National Metallurgical Laboratory (NML), Jamshedpur (a CSIR unit).
6. Served as an expert for faculty/scientist selection in National Institute of Foundry and Forge Technology (NIFFT), Ranchi; National Metallurgical Laboratory (NML), Jamshedpur; and National Institute of Technology (NIT), Durgapur.
7. Served in the National Organizing Committee of the Annual Technical Meeting of the Indian Institute of Metals in 2005 (Chennai), 2006 (Jamshedpur) and 2007 (Mumbai).
8. Serving in the Editorial Board of STEEL TECH, a bi-monthly bulletin on Steel published by Tata Steel.
9. Served as a member of the Program Advisory Committee of NANO 2006 (An International Conference in Bangalore in Aug. 2006).
10. Served as Guest Editor of a special issue of the Transactions of the Indian Institute of Metals on NanoScience and Technology [Vol. 58(6), 2005].
11. Deputy Managing Editor of Metal News, a bi-monthly bulletin of the Indian Institute of Metals, Kolkata from August 2005 onwards.
12. Serving the National Council of the Indian institute of Metals since 2004 and maintaining the IIM web site (www.iim-india.net)
13. Serving as a member of the Board of Editors for the International Scientific Journal Computers, Materials and Continua, published by Tech Science Press international journal (ISSN 1546-2218), California, USA.
14. Coordinator, Session on Nanotechnology, MEMS-NANO – An International Conference at the IIT-Kharagpur in Dec 2005.
15. Member, Advisory Committee, ICAMMP 2006 (International Conference on Advanced Materials and Materials Processing), IIT Kharagpur, Feb 2006.
16. Member, National Organizing Committee, National Laser Symposium, Indian Laser Association, IIT-Kharagpur, December 22-24, 2003.
17. Member, Curriculum Revision Committee on Materials Engineering, Indian National Engineering Academy (INAE), 2003.
18. Referee, Acta/Scripta Mater. (Elsevier Science); J. Appl. Phys. (Amer. Inst. of Phys.), Appl. Surface Science (Elsevier), Metall. & Mater. Trans. (ASM, USA), Philos. Mag. (Gordon & Breach), J. Mater. Research (MRS).
19. Referee, Bulletin of Materials Science, published by Indian Academy Of Sciences, Bangalore.
20. Expert, SRF & RA Selection Committee and Project Review Expert of CSIR.
21. Expert, Young Scientist Selection and Project Evaluation of the CSIR.
22. Paper Setter & Examiner - B.E. College (Cal. Univ.).
23. Paper Setter & Examiner - Indian Inst. of Metals, AMIIM Examination.
24. Examiner - Inst. of Engineers (India), AMIE (I) Examn.
25. Examiner - Graduate Aptitude Test (GATE), IIT-Kharagpur.
26. Examiner - Joint Entrance Examination (JEE), IIT-Kharagpur.
27. Examiner - confidential work related to GATE and JEE at the IIT-Kharagpur.
28. Examiner – PhD, MS, BS thesis – I.I.Sc., Bangalore, B.E. College (Cal. Univ.).
29. Consultant, Consultancy project from Century Extrusions Ltd., Nimpura, Kharagpur.

30. Principal Consultant, EPCOS Ferrites Ltd, Kolkata.

16. Membership of Academic/Professional Bodies:

1. Fellow, The World Academy of Sciences (TWAS)
2. Fellow, Asia-Pacific Academy of Materials Sciences
3. Fellow, Electron Microscopy Society of India (EMSI), Kolkata
2. Fellow, Indian National Science Academy (INSA), New Delhi
3. Fellow, West Bengal Academy of Science & Technology (WAST), Kolkata
4. Fellow, Indian Academy of Sciences (IAS), Bangalore
5. Fellow, The National Academy of Sciences, India (NASI), Allahabad
6. Fellow, Indian National Academy of Engineering (INAE), New Delhi
7. Fellow, Institution of Engineers (India), Kolkata
8. Life Fellow, Indian Institute of Metals, Kolkata
9. Member, National Academy of Sciences, Allahabad, India
10. Life Member, Indian Institute of Metals (I.I.M.), India.
11. Life Member, Materials Research Society in India (MRSI), India.
12. Life Member, Indian Laser Association (ILA), India.
13. Life Member, Indian Science Congress Association (ISCA), India.
14. Life Member, Plasma Science Society of India (PSSI), PRL, Ahmedabad.
15. Life Member, Texture Society of India (TSI), DMRL, Hyderabad.
16. Member, Materials Advantage [American Society of Metals (ASM), The Materials Society (TMS), The Association for Iron & Steel Technology (AIST) and the American Iron and Steel Institute (AISI)] USA

17. Academic Visits to University/Institute/Laboratory:

1. Univ. of Saarbruecken, Germany (Prof. H. Gleiter) Feb.'90.
2. Univ. of Bochum, Germany (Prof. E. Hornbogen), Feb.'90.
3. Univ. of Munster, Germany (Prof. Chr. Herzig), Feb.'90.
4. National Metallurgical Lab., Jamshedpur, India (Prof. O. N. Mohanty), Jul.'90.
5. Ind. Inst. of Science., Metall. Dept., Bangalore, (Prof. K. Chattopadhyay), Mar.'91
6. Regional Research Lab., Bhubaneshwar, India (Prof. H. S. Ray), Sept.'91.
7. Mass. Inst. of Tech. (MIT), USA (Prof. Morris Cohen), Dec.'91.
8. Harvard University, USA (Prof. D. Turnbull), Dec.'91.
9. Defense Metall. Research Lab., Hyderabad, India (Dr. C. R. Chakraborti), Oct.'92.
10. Centre for Advanced Technology, Indore, India (Dr. A. K. Nath), Oct.'92.
11. National Chemical Metallurgical Lab., Bombay, India (Dr. D.K. Biswas), Mar.'94.
12. University of Sheffield, UK (Profs. H. A. Davies, H. Jones), May'95.
13. Imperial College, London, UK (Profs. D. R. F. West, H. M. Flower), May'95.
14. Univ. of Cambridge, UK (Dr. H. Bhadeshia, Dr. C. L. Clyne), May'95 and Jun.'98.
15. The Welding Institute, Abbingdon, UK (Dr. P. Hilton), May'95.
16. National Physical Laboratory, Teddington, UK (Dr. S. R. J. Saunders), May'95.
17. University of Manchester, UK (Profs. G. W. Lorimer, F. J. Humphreys, Drs. N. Ridley, R. Elliot, R. I. Todd), Jun.'95 and Jun.'98.
18. University of Leeds, UK (Prof. D. V. Edmonds, Dr. R. F. Cockrane), Jun.'95.
19. University of Birmingham, UK (Prof. T. Bell), Jun.'95.
20. Fraunhofer Inst. f. Lasertechnik, Aachen, Germany (Dr. A. Gasser and Dr. A. Weisheit), Dec.'95 and Dec.'99.

21. Technische Universitaet, Clausthal, Germany (Prof. Dr. B. L. Mordike), Dec.'95, May'97, Jun.'98, Dec.'99, May'00.
22. Technische Universitaet, Berlin, Germany (Prof. Dr. H. J. Fecht), Dec.'95.
23. RWTH, Aachen, Germany (Prof. Dr. G. Gottstein), Dec.'99.
24. IFSW, Univ. Stuttgart, Germany (Dr. F. Dausinger), Dec.'99.
25. Wright State Univ., Dayton, USA (Prof. S. Mukhopadhyay), Mar.'00.
26. ARL, Penn. State Univ., USA (Dr. P. Martukanitz), Mar. '00.
27. UTSI, Univ. of Tennessee, USA (Prof. N. B. Dahotre), Mar. '00.
28. IFW, Dresden, Germany (Prof. Dr. L. Schultz), May '00.
29. IWW, TU-Clausthal, Germany (Prof. Dr. Y. Estrin), Dec.'01
30. IIT-Technion, Haifa, Israel (Prof. E. Rabkin), Mar.'02.
31. Unipress (Polish Academy of Sciences), Warsaw (Prof. W. Lojkowski), Apr.'02.
32. Warsaw University of Technology, Warsaw, Poland (Prof. T. Kulik), Apr.'02.
33. Inst. of Metallurgy & Mater. Sci. (IMIM), Polish Academy of Sciences, Krakow, Poland (Profs. J. Dutkiewicz, P. Zieba), Apr.'02.
34. Mech. & Manufac. Engg. Dept., UMIST, Manchester, U.K. (Prof. Lin Li), May '02.
35. Department of Engineering, University of Liverpool, UK (Prof. D. Bacon), May'02.
36. Mater. Sci. Division, Argonne National Lab., USA (Dr. J. A. Eastman), June'02.
37. Mater. Sci. Engg. Dept., Ohio State Univ., USA (Prof. M. Mills), June '02.
38. Dept. of Physics, Univ. Delaware, USA (Prof. G. Hadjipanayis), June '02.
39. Institute of Solid State Physics, Chernogolovka, Russia (Prof B Straumal), May '03.
40. Advanced Research Center for Powder Metallurgy (ARC-I), Hyderabad, India (Dr. G. Sundararajan), July '03.
41. Technical University of Clausthal, Clausthal-Zellerfeld (Prof Dr J Estrin), Jun.2004.
42. Technical University of Darmstadt, Germany (Prof Dr J Eckert), Jun.2004
43. Ecole des Mines, Saint Etienne, France (Dr A Fraciewicz), Jun.2004.
44. Ecole Nationale de Ingenieur (ENISE), St Etienne, France (Prof I Smurov), Jun.2004.
45. Indian Institute of Science, Bangalore, India (Prof T Abhinandan), Aug. 2004.
46. India Science Center, General Motors, Bangalore, India (Dr A Tewari), Aug. 2004.
47. Defense Metallurgical Research Lab., Hyderabad (Dr A Sriramamurty), Apr. 2005.
48. Indira Gandhi Center for Atomic Research, Kalpakkam (Dr S L Mannan), May 2005.
49. University of Central Florida, Orlando, Florida, USA (Prof S Seal), June 2005.
50. University of British Columbia, Vancouver, Canada (Prof M Wells), July 2005
51. University of Chile, Santiago, Chile (Prof R Leteier), June 2006
52. University of Trinidad and Tobago, Port of Spain (Prof K D Srivastava) Aug. 2006
53. High Pressure Research Institute, Warsaw, Poland (Prof W Lojkowski), Aug. 2006
54. National Inst of Foundry Forge Tech, Ranchi, India (Prof M K Banerjee), Sept 2006
55. Sociedade Portuguesa da Inovação (SPI), Porto, Portugal (Dr Rachel Newton), Sept 14-15, 2006 (under Euro-Net project on Nanotechnology).
56. Federal University of Rio Grande do Sul (UFRGS) (Nov 6), National Inst. Of Metrology, Standardization, and Industrial Quality (INMETRO) (Nov 7), CENPES/Petrobrás (Industry) and Min. of Development, Industry and Foreign Trade (UFRJ) (Nov 8), Instrumentation Center for Agriculture (EMBRAPA) and Institute of Chemistry and Physics, State University of Campinas (UNICAMP) (Nov 9), Synchrotron Center (LNLS), Campinas (Nov 10) (Host: J A Brum, I Hümmelgen and S Guterres, under the India-Brazil-South Africa Joint Program) on Nov 5-11, 2006.
57. Inst. For Plasma Research (IPR), Gandhinagar (Dr S Mukherjee), Nov 24, 2006
58. Georgia Technological Univ, Atlanta, USA (Prof WO Winer, Y Joshi), Mar 26'2007
59. Wright State University, Dayton, USA (Prof S Mukhopadhyay), Mar 28, 2007
60. Colorado School of Mines, Golden, USA (Prof B Mishra), Mar 29, 2007.
61. Inst. for Mater. Res., GKSS, Geesthacht, Germany (Prof K U Kainer), Jun 15, 2007.
62. Unipress - High Pressure Research Institute, Warsaw, Poland (Prof W Lojkowski) Sept. 2007.
63. Dept of Materials, Univ. of Queensland, Australia (Prof G Schaffer) and Dept of Materials Engineering, Monash University, Australia (Prof Y Estrin), Oct. 2-6, 2007.

64. Ithemba Laboratory (Cape Town), Silver Lakes (Pretoria), NECSA and Mintek (CSIR), Johannesburg and KwaMaritane, South Africa (N Coville, T Hille, N Marule) Nov 18-25, 2007 (under India-Brazil-South Africa – IBSA tripartite collaboration on Nanotechnology).
65. University of Witwatersrand, Johannesburg, South Africa (N. Coville, B Tait) Aug 25-30'08.
66. CSIR Nanotechnology Laboratory, Pretoria, South Africa (S Sinharay) Aug. 27, 2008.
67. Helmholtz Centre Berlin for Materials and Energy (Hahn Meitner Institut), Germany (J Banhart, G Schumacher) Jan 23, 2009.
68. Tokyo Institute of Technology (Yokohama Campus), Japan (M Kajihara), 19 June 2009
69. WPI, Tohoku University, Sendai, Japan (A Inoue, D Louzguine) 23 June 2009 ; and IMRAM, Tohoku University, Sendai (H Fukuyama) 16 June 2009.
70. NIMS, Tsukuba, Japan (K Hono) June 2009.
71. University of Strasbourg, France (F Banhart) on June 19, 2018.
72. Seoul National University, Seoul on May 17, 2018.
73. Pohang, South Korea on May16, 2018.
74. Changwon, South Korea on May 14, 2018.
75. University of Ulm, Germany during May-Jun 2018.
76. University of Strasbourg, France on Jun 18-20, 2018.
77. Univ Ulm (June 2019) including lecture trips to Univ Bremen (Jun 11'19) and Univ Muenster (Jun 26'19)
78. Wuhan Inst of Sci & Tech (Wuhan, China) – on Laser Surface Engineering (20Dec19)

18. Invited Talks/Lectures (national/international):

1. **Science – Engineering – Technology: Synergy for Sustainable Growth**
 - (a) Distinguished Lecture Series of *INAE Bhubaneswar Chapter*, SOA University and CSIR-IMMT, 7 December 2021
 - (b) 12th University Distinguished Lecture, *SRM University*, Amravati, AP, 25 September 2021
 - (c) Inauguration of the Centre for Intelligent Cyber Physical Systems, Engineers Day Celebration, *IIT Guwahati*, 15 September 2021
 - (d) Webinar on Engineering for Sustainable Growth, *Institution of Engineers (India)* Centenary Celebration, 6April2021
2. **Microstructure – the Key to Designing and Developing Engineering Solids**, Central Research Facility, *IIT Kharagpur*, Seminar on Microstructural Characterization, 13Nov2021
3. **Novelty of Nano-metric Phase Dispersion in Solids and Fluids**, Emerging Nanomaterials for Sustainability, AICTE-STTP, *Maulana Abul Kalam University of Technology* (MAKAUT), Kolkata, 30Aug 2021
4. **Prospects and Opportunities of Laser Assisted Additive Manufacturing**, Metallurgy & Materials Technology – *2nd International Conference (on virtual platform)*, New Delhi - *Emerging Trends, Development & Applications*, 29 June 21
5. **Perspectives and Prospects of Laser Assisted Additive Manufacturing**, 32nd Daya Swarup Memorial Lecture, *Indian Institute of Metals* – Annual Technical Session, 24 February 2021
6. **Challenges in Implementation of NEP 2020 in Engineering Education** – Moderator and Host of a Panel Discussion, *IIST Shibpur*, Global Alumni Day, 27 December 2020
7. **Microstructure–Property Correlation in Engineering Solids**, Conference of Processing and Characterization of Materials (CPCM) 2020, Metallurgical & Materials Engineering Department, *NIT Rourkela*, 18Dec2020

8. **Science ↔ Engineering ↔ Technology Nexus for Translational Research and Engineering Innovation**, Acharya PC Ray Vigyan Yatra, **CSIR-IMMT**, 6th India International Science Festival of DST, 15 December 2020
9. **Science–Engineering–Technology Nexus for Translational Research in Nano-Science and Technology**, STARS Workshop on Grant Writing, Ministry of Education, **SN Bose Center for Basic Sciences, Kolkata**, 8 December 2020
10. **Metal Additive Manufacturing: Particle to Product** – Tata Steel R&D (Webinar), 28 August 2020
11. **Additive Manufacturing (AM) Webinar** at (i) National Institute of Foundry & Forge (NIFFT) **Ranchi**, 28 September 2020, and (ii) 70th Foundation Day Lecture (online) of CSIR-National Metallurgical Laboratory (NML), **Jamshedpur**, 26 November 2020
12. **Magnetic Field Controlled Rheological and Dynamical Properties of Magnetite Dispersed Water Based Ferrofluid**, ICONSAT 2020, Biswa Bangla Convention Center, **SN Bose Center for Basic Sciences, Kolkata**, 7 March 2020
13. **Challenges for Development of Materials and components for High Temperature Structural Applications** (Science Day Lecture), **ARCI Hyderabad**, 27 February 2020
14. **Microstructure–Property correlation in Engineering Solids**, Prof. ML Kapoor Lecture, Metall. & Mater. Engg. Dept., **IIT Roorkee**, 18 February 2020
15. **Innovation through inter-disciplinary Translational Research, Theme Meeting for Creation of Inter-Academy Innovation Cell**, Indian National Science Academy (INSA), **New Delhi**, 04 February 2020
16. **Laser aided surface engineering and additive manufacturing of steel**, Steel Technology Festival, **New Delhi**, 21 January 2020
17. **Development of Materials and Related Challenges for High Temperature Structural Applications**, ADTHERM2020 Conference organized by VSSC, Trivandrum, 19 Jan 2020
18. **Technology Development – The Last and Elusive Mile**, Humboldt Kolleg “FLOW”, **Humboldt Club of Kolkata**, Raichak on Ganges, 04 January 2020
19. **Nanostructured solids by mechanical alloying and laser surface engineering for specific structural & functional application**, Key Laboratory of Refractories and Metallurgy, Wuhan University of Science & Tech (WUST), **Wuhan, China**, 29 Dec 2019
20. **Laser assisted Surface Engineering of Metals**, WUST, **Wuhan**, China, 20 Dec 2019
21. **Leadership for Academic Excellence and Technology Development** – Special Lecture for Leadership for Academicians Programme (LEAP) delivered at:
 - (a) IIT BHU **Varanasi**, 10 December 2019
 - (b) IIT **Kharagpur**, 18 November 2019
 - (c) IIT **Kharagpur**, 21 May 2019
22. **Advanced Materials for High-temperature Structural Applications**, Workshop on Future Landscape of Structural Materials in India (FLSMI) under INAE Forum on *Indian Landscape of Advanced Structural Materials*, Venue: Imperial Room (Lobby Level), Hotel Pride Plaza, **New Town, Kolkata**, 7 December 2019
23. **Laser Assisted Material Processing and Additive Manufacturing (3d Printing) of Metallic Components, Powder Metallurgy and Additive Manufacturing**, AICTE Short Course, Metall. & Mater. Engg. Dept., **IIT Kharagpur**, 11 November 2019
24. **Microstructure–Property Correlation in Engineering Solids**, NMD Week Celebration, Indian Institute of Metals, RINL, **Visakhapatnam Chapter**, 9 November 2019
25. **The Path to Technology Development by Academia-Industry Interaction**, Industry-Academia Conclave, India International Science Festival (IISF), DST, **Kolkata**, 06 Nov 2019
26. **Laser Assisted Material Processing and Additive Manufacturing of Metallic Components**, International Conference on Lasers in Manufacturing (CALM) 2019, ARCI Hyderabad, Laser Photonics, Bombay Exhibition Center, **Mumbai**, 17 October 2019
27. **Nanostructured solids by mechanical alloying for engineering (structural and functional) applications**, Belarus-India Seminar on Nano & Advanced Materials, Bilateral Cooperation Delegation of DST, **Minsk, Belarus**, 27 September 2019
28. **Towards Academic Excellence and Technology Development**, Engineers’ Day Celebration 2019, **INAE Kolkata Chapter** (at IET, Salt Lake), 18Sept2019

29. **Evolution of Microstructure in Laser Assisted Material Processing and Surface Engineering of Metals**, WW-IfW, **Ruhr University of Bochum**, Germany 10 Sept 2019
30. **Towards Academic Excellence and Technology Development**, delivered at:
 - (a) Research Scholar Colloquium, BIT Mesra, **Ranchi**, 1 September 2019
 - (b) TEQIP Phase III Programme Collaborative Research Scheme for Project Faculty, AICTE, **New Delhi**, 16 July 2019
31. **Laser assisted Surface Engineering for High Temperature Protection**, **INAE-NAEK Workshop** (MIDHANI) **Hyderabad**, 15 Jul 2019
32. **Magnetic Field Controlled Rheological and Dynamical Properties of Magnetite Dispersed Water Based Ferrofluid**, ISMANAM-2019 Chennai, 9 July 2019
33. **Novelty of metallic or ceramic nano-particle dispersed nanofluid and ferrofluid**, Inst Materials Physics, University **Münster, Germany**, 2 July 2019
34. **Laser Assisted Material Processing and Surface Engineering of Metallic Systems**, Institut f. Werkstoff Technologie (IWT), **University of Bremen**, Germany on 11 June 2019
35. **Materials Science Engineering Technology – Opportunities and Challenges**
 - (a) National Workshop on Recent Advancements in Science & Technology, RK Mission, **Narendrapur, Kolkata**, 20 April 2019
 - (b) Research Scholars' Day, Mater Sci & Engg Dept, **IIT Kanpur**, 6 April 2019
 - (c) TEKON 2018 of Kerala State Council S&T Education, Sahridaya College, Thrissur, 23 February 2018
36. **Microstructure–Property correlation in Engineering Solids**, National Science Day, CSIR-Structural Engineering Research Center (SERC), **Chennai**, 27 February 2019
37. **Size Dependent Polymorphic Change in Early Transition Metals Induced by Mechanical Attrition and Milling**, Mineral Processing & Mechanical Activation of Solids, CSIR-National Metallurgical Laboratory (NML), **Jamshedpur**, 22 February 2019
38. **Novelty of metallic or ceramic nano-particle dispersed nano/ferrofluid**, HIPSTER Workshop on Materials Science, Zuri Whitefield, **Bengaluru**, India, 13-14 February 2019
39. **System Engineering and Institution Building**, in: *Perspectives on the Role of Translational Research*, Colloquium on System Engineering and Institution Building, IIST and VSSC, **Thiruvananthapuram**, 9th February 2019
40. **Laser assisted Processing of Engineering Materials and Components - Additive Manufacturing of Metals: Current Issues and Way Forward (Plenary Talk)**– NML, Indo-German Bilateral Workshop, 4-6 February 2019
41. **Evolution of microstructure and properties in (i) Ceramic Dispersed ferritic alloys and (ii) ceramic coated metallic systems**, Annual Session of Indian Ceramic Society, Jamshedpur, 9 January 2019
42. **Laser Assisted Processing of Engineering Material and Component**, delivered at:
 - (a) 7th International Conference on Solidification Science & Processing, **Kovalam, Kerala**, 19-21 Nov 2018
 - (b) 72nd ATM of **IIM, Kolkata** on 15th Nov 2018
 - (c) Warwick Manufacturing Group (WMG), University of Warwick, **Coventry**, UK on 31 October 2018
 - (d) VSSC (ISRO) **Trivandrum** on 20 February 2018
 - (e) National Inst of Foundry & Forge (NIFFT) **Ranchi**, 13 January 2018
 - (f) National Laser Symposium (NLS 26), BARC, **Mumbai**, 20 December 2017
43. **Novelty of metallic or ceramic nano-particle dispersed nanofluid and ferrofluid**, BIT's 8th Annual Congress on Nano S&T, Templiner See, **Potsdam**, Berlin, 24-26 October 2018
44. **Evolution of microstructure in developing high temperature resistant ODS alloys and laser assisted coatings**, 39th Annual Meeting of EMSI at **Bhubaneswar**, 18 July 2018
45. **Novelty of Nano-dispersed Solid Alloys and Thermal Fluids** delivered at:
 - (a) Institute of Physics and Chemistry of Materials, **University of Strasbourg**, France on 19 June 2018
 - (b) Materials Science & Engineering Dept., **Seoul National University**, Seoul, South Korea on 17 May 2018

46. **Microstructure-Property Correlation in Bulk and Surface Engineered Steel**, POSTECH, *Pohang, Korea*, 16 May 2018
47. **High Temperature Resistant Metallic Alloys and Coatings**, INAE-NAEK Workshop on HIGH TEMPERATURE MATERIALS, KIMS, *Changwon, Korea*, 14 May 2018
48. **Evolution of Microstructure in Engineering Materials**, CSIR-Institute for Minerals and Materials Technology (IMMT), *Bhubaneswar*, 13 April 2018
49. **Novelty of metallic and ceramic nano-particle dispersed water and ethylene glycol based nanofluid and ferrofluid**, 2nd Research Scholars' Day, SNST, *IIT Kharagpur*, 12 March 2018
50. **Laser Assisted Surface Engineering of Metallic Systems**, Physics of Surfaces, Interfaces & Nanostructures, IACS and SNBCBS, *Kolkata*, 25 November 2017
51. **Evolution of Microstructure in Engineering Materials**, Aero Society India, RCI, *Hyderabad*, 22 January 2017
52. **Materials: An Interface between Society and Science**, 3rd Indo-Austrian Symposium on Advances in Materials Engineering, *IIT Bombay*, 19.12.2016
53. **Discontinuous Precipitation - A Model Moving Boundary Phase Transformation**, ICAMMP IV, *IIT Kharagpur*, 06.11.2016
54. **Materials: An Interface between Society and Science**, CV Sundaram Memorial Lecture, *IIM Mumbai Chapter, IIT Bombay*, 24.09.2016
55. **Materials Engineering: An Interface between Society and Science**, Prof. Brahm Prakash Memorial Lecture, *IISc Bangalore*, 21.08.2016
56. **Evolution of Microstructure in Engineering Materials**, MCP, *IIST Shibpur*, 29.07.2016
57. **Size Dependent Polymorphic Change in Early Transition Metals Induced by Mechanical Attrition/Milling**, ICMR 2016, *IISc Bangalore*, 20.06.2016
58. **Novelty of Nano-Dispersed Solid Alloys and Thermal Fluids**, NMNC 2016, *KIIT Bhubaneswar*, 29.01.2016
59. **Materials Science Engineering and Technology**, Saint Gobain 350, Research Park, *IIT Madras, Chennai*, 28.01.2016
60. **Development and Characterization of New Age Hardenable Amorphous Matrix Al-Alloys Synthesized by Mechanical Alloying**, Advances in Light Metals and its Composites, *SRM University, Chennai*, 06.12.2014
61. **Tailoring of Microstructure and Properties for Materials Development**, International Conference on Emerging Materials: Characterization and Applications, *CSIR-CGRI Kolkata*, 04.12.2014
62. **Development and Characterization of New Age Hardenable Amorphous Matrix Al-Alloys Synthesized by Mechanical Alloying**, TWAS 2013 Prize Ceremony and 25th General Meeting, *Muscat, Oman*, 26.10.2014
63. **Materials Engineering: An Interface between Society and Science**, Prof Brahm Prakash Memorial Lecture, *IGCAR Kalpakam*, 19.09.2014
64. **Nanometric Phase Dispersed Metal Matrix Composites- A New Class of Age Hardenable Amorphous Al-Alloy**, Leopoldina-INSa Symposium on Nanosciences, *Halle*, 25.11.2013
65. **Materials Science and Engineering: An Interface between Society and Technology**, Placid Rodriguez Memorial Lecture, *IGCAR Kalpakam*, 05.10.2013
66. **Materials Engineering Challenges Concerning High Temperature Materials and Structures for Space Applications**, Brahm Prakash Birth Centenary Workshop, High Temperature Materials and Hot Structures, *ISRO-IIM Trivandrum Chapter, Trivandrum, Kerala*, 13.05.2013
67. **Lectures on I. Physical Metallurgy of Steel II. Corrosion of Steel**, AcSIR Program of *CSIR-CBRI, Roorkee*, 26.04.2013

68. **Novelty of Thermophysical Properties of Nano-Metallic/Ceramic Dispersed Water/E-Glycol Based Nanofluids**, India-Singapore Workshop on Advanced Materials and Energy, IACS Kolkata, 22.04.2013
69. **Novelty of Steel: Microstructure and Property Correlation in Bainite+Martensite Steel**, Annual General Meeting of IIM Kanpur Chapter, IIT Kanpur, 12.04.2013
70. **In Pursuit of Excellence, Research Scholars' Day**, IIT Madras, 25.03.2013
71. **Novelty of Thermophysical Properties of Nano-Metallic/Ceramic Dispersed Water/E-Glycol Based Nanofluids**, Aluminas 2013, CSIR-CGCRI Kolkata, 07.03.2013
72. **Novelty of Steel: Microstructure and Property Correlation in Bainite + Martensite Steel**, International Conference on Advanced Materials for Energy Efficient Buildings, CSIR-CBRI, Roorkee, IHC, New Delhi, 14.02.2013
73. **Materials Design by Tailoring the Microstructure Through Thermodynamic Modeling and Experimental Simulation**, International workshop on Computational Materials Design and Engineering, IIT Jodhpur, 08.02.2013
74. **Novelty of Thermophysical Properties of Nano-Metallic/Ceramic Dispersed Water/E-Glycol Based Nanofluids**, AMPC 2013, Anna University, Chennai, 06.02.2013
75. **Development of Bioceramic Prosthesis and Implants at CSIR-CGCRI**, Kolkata, BIND-12, IISc, 09.12.2013

19. Extra-curricular activities:

1. **Captained Nadia District Junior cricket team** in 1977-79.
2. **Captained B.E. College cricket team** in 1982-83.
3. **Represented I.I.T. Kanpur in Inter-IIT sports Meet** (cricket & volleyball) in 1984.
4. **Participated** in several All India Radio (Calcutta) **Science Quiz Programmes**.
5. **Represented I.I.T. Kharagpur (cricket) at the Inter-IIT Staff Meet** in 1986-87.
6. **Member, Executive Council, Global Alumni Association of BESU**, Howrah, (2009-2011).

20. Most Significant Scientific and Research Contributions:

In Surface Engineering:

In the recent past, Professor Manna has been more active in the area of surface engineering of various grades of steel or ferrous alloys like tool steel, carbon/bearing steel, ferritic/austenitic stainless steel, austempered ductile iron (ADI). His earlier studies on laser surface engineering (LSE) of Ti/Cu/Mg/nimonic alloys, demonstrated that LSE (hardening/alloying/cladding) could provide very novel, economical and effective protection metallic alloys against friction, wear, corrosion, oxidation, erosion and similar surface degradation processes. The metastable microstructure and composition retained in LSE entails such significant enhancement. Principal novelty here lies in structure-property-parameter correlation achieved through detailed characterization, testing and modelling.

Majority of these efforts were based on laser surface alloying (LSA), cladding (LSC), melting (LSM), hardening (LSH) or composite surfacing (LCS) of different ferrous and non-ferrous metallic alloys to induce significant extension of solid solubility, enforce beneficial phase transformation, form of metastable phases/phase aggregate, develop compositionally and/or microstructurally graded surface layer, restore and refurbish worn components, and even, design and fabricate miniature complex components by direct manufacturing. These efforts led to significant improvement in hardness, friction coefficient, and resistance to wear, erosion, corrosion, oxidation and similar surface dependent degradation of engineering components, for example:

In Nanostructured Materials:

Most notable scientific contributions of Professor Manna over last two decades concerning phase transformation and structure-property correlation in nanostructured solids are: (i) size dependent polymorphism in early transition metals below a critical crystallite size due to structural instability, (ii) enhanced diffusivity and boundary softening at room temperature due to nanocrystallization, (iii) paramagnetic to superparamagnetic transition of Mn-Zn ferrites in ultrafine regime, (iv) ultra-high strengthening (1500-1800 MPa) of amorphous Al-alloys due to in-situ nano-intermetallic precipitation or ex-situ nano-oxide dispersion in glassy matrix, (v) high conductivity Cu(Cr/Ti) alloys with ~55% IACS and high wear resistance due to nano-oxide dispersion, (vi) 25-50% improvement in thermal conductivity in nanofluids (stable colloidal dispersion of nanometric solids in conventional thermal fluids), (vii) very attractive reversible magnetization behaviour in ferrofluids, (viii) highly sensitive (and selective) gas sensing property of ZnO-SnO₂(Pd) nanometric thin films synthesized by PLD, (ix) special FeCrTiAl ferritic alloys with nano-yttria dispersion to reach extremely high compressive strength, elastic modulus, fracture toughness and hardness with > 10 % ductility, and (x) low alloy high carbon bainite+martensite duplex steels with over 1500-MPa strength due to nano-ferritic sheaves with 10-20 nm dispersed carbides.
