


**Bio-Data**  
of  
**Dr Anoop Kumar Mukhopadhyay**

|                                |  |   |
|--------------------------------|--|---|
| <b>Name</b>                    | <b>Dr Anoop Kumar Mukhopadhyay</b>   |  |
| <b>The SOP:</b>                | <i>To continue to grow and contribute to academia, research, and innovation as part of the organization which wants to be globally one of the most preferred destination for interactive and multidisciplinary learning through rendition of enhanced mentoring and leadership skills.</i> |   |
| <b>Immediate Past Position</b> | Professor, Department of Physics, and Dean, Faculty of Science, Manipal University Jaipur, Jaipur 303007, Rajasthan, India (08 Dec 2018 to 06 Dec 2021).   |   |
| <b>Present Position</b>        | Professor, Department of Physics, and Dean, Faculty of Science, Biyani Girls College, Jaipur 302039 (13 December 2021 to date).  |   |
| <b>Current Address</b>         | Villa Number 6, Second Street, Ivy Homes, Vatika Infotech City, Jaipur 302026, Rajasthan, India.   |   |
| <b>Permanent Address</b>       | Flat No. 9, A 80 New Raipur Road, Kolkata 700084, India  |   |
| <b>Contact Details:</b>        | Mobile: 9433910371/8420454713 (also WhatsApp Number).<br>E-mail: mukhopadhyay.anoop@gmail.com  |   |
| <b>Date of Birth</b>           | 23.07.1958   |   |

**Educational Qualification:**

| <b>Institution</b>   | <b>Specialization</b>        | <b>Degree</b>  | <b>Year</b>       |
|--|------------------------------|--|-------------------|
| <i>Ranaghat P.C.H. School, West Bengal</i>   | <i>Science Stream</i>        | <i>Higher Secondary Examination of West Bengal Board of Secondary education [61.4%]/1<sup>st</sup> Divison</i> | <i>1973</i>       |
| <i>Kalyani University, Kalyani, West Bengal</i>  | <i>(Physics Major)</i>       | <i>Bachelor of Science (B. Sc.) [62.55%]/1<sup>st</sup> Class First</i>  | <i>1978</i>       |
| <i>Jadavpur University, Kolkata 700032, India</i>  | <i>Physics</i>               | <i>Master of Science (M.Sc.), [64.4%, 1<sup>st</sup> Class]</i>  | <i>1982</i>       |
| <i>Jadavpur University, Kolkata 70032, India</i>   | <i>Science</i>               | <i>Ph.D.</i>   | <i>1988</i>       |
| <i>Sydney University, Sydney, Australia</i>  | <i>Post-Doctoral studies</i> | <i>Post-Doctoral studies</i>   | <i>1990-1992</i>  |
| <i>Forshungszentrum, Juelich, Germany<br/>University of Saarbrucken, Saarland, Germany</i> | <i>Post-Doctoral studies</i> | <i>Post-Doctoral studies</i>   | <i>2000, 2010</i> |

**Employment Experience:**

| Organization  | Position  | Year                        |
|---|---|-----------------------------|
| CSIR-CGCRI, Kolkata 700032, India   | Junior Scientist                                  | 03-Dec-1986 02-Dec-1989     |
| CSIR-CGCRI, Kolkata 700032, India   | Scientist   | 03-Dec-1989 02-Dec-1994     |
| CSIR-CGCRI, Kolkata 700032, India   | Senior Scientist                                  | 03-Dec-1994 02-Dec-1999     |
| CSIR-CGCRI, Kolkata 700032, India   | Principal Scientist                               | 03-Dec-1999 02-Dec-2005     |
| CSIR-CGCRI, Kolkata 700032, India   | Senior Principal Scientist                        | 03-Dec-2005 to 02-Dec-2011  |
| CSIR-CGCRI, Kolkata 700032, India   | Chief Scientist                                   | 03-Dec-2011 to 31-July-2018 |
| Manipal University Jaipur, Manipal University Jaipur, Jaipur 303007, Rajasthan, India | Professor of Physics and Dean, Faculty of Science | 08-Dec-2018 to 07-Dec-2021  |
| Biyani Girls College  | Professor of Physics and Dean, Faculty of Science | 13-Dec-2021 to Date         |

**Research Related Working Experience:****About 36 years in**

- ✚ Physics of Deformation and Fracture.
- ✚ Nanomaterials Development.
- ✚ Evaluation of Mechanical Properties including the Nano Indentation Technique based Characterization.
- ✚ Non-Destructive Testing and Ultrasonic Characterization.
- ✚ Structure Property Correlation.
- ✚ Tribology and Fatigue of Structural and Bio-Ceramics as well as Ceramic Composites including Multilayer Composites.
- ✚ Thermal Barrier Coating (TBC).
- ✚ Thin Films for Defense and Space Applications.
- ✚ Functional Ceramic Coatings.
- ✚ Nanoceramic Oxides for Structural Applications.
- ✚ Nanoceramic Hydroxides for Functional Applications.

**Publications:****Total Publication including Journals and Conferences: 344**

- **SCI/SCOPUS Journal Papers: 182**
- **Conference Papers: 162**
- **Citations:4304, h-index:35, i-10 index:112**  
([https://scholar.google.co.in/citations?view\\_op=list\\_works&hl=en&user=tcFVCpAA AAAJ](https://scholar.google.co.in/citations?view_op=list_works&hl=en&user=tcFVCpAA AAAJ))
- **Patents – 7 (Indian)**
- **• Books: 3 - Published from CRC Press USA in 2015, 2016 and 2018 on Nanoindentation**
  - **Book Chapters: 5**
  - **Indian Patents: 7**
- <https://scopus.com/authid/detail.uri?authorid=7201817042>
- <https://www.mendeley.com/profiles/dr-anoop-mukhopadhyay>

- <https://orcid.org/0000-0003-3160-7078>

### **Post-Doctoral Experience:**

- ❖ Guest Scientist, Dept. of Mechanical & Mechatronic Engineering, University of Sydney, Australia, 1990-1992.
- ❖ Invited Speaker, University of Technology of Sydney, Australia, 1991.
- ❖ Guest Lecturer, Sydney University, Australia, 1991.
- ❖ Guest Lecturer, University of New South Wales, Australia, 1992.
- ❖ Guest Scientist, Forshungszentrum, Juelich, Germany, Feb.-Aug., 2000.

### **Academic Experience:**

- Guest Lecturer, Quality Improvement Program for College Teachers, IIT, Kharagpur, India, 1993.
- Guest Lecturer, Jadavpur University, 1998-1999.
- Guest Lecturer, Calcutta University, 1997-1998.
- Invited Speaker, Solid State Physics Research Center, Physics Dept., Jadavpur University, Calcutta, India, 1993, 1995, 1997, 1998, 1999, 2001.
- Invited Speaker, Zonal Meet of the Confederation of Indian Industries, Kolkata, 1997.
- Invited Speaker, Quality Improvement Program for College Teachers, Calcutta University, Kolkata, 2001.
- External Examiner, Jadavpur University, Kolkata 700 032, India.
- External Examiner, Calcutta University, Kolkata, India.

### **International Recognition as Expert:**

#### **I am internationally recognized as a Reviewer for the following journals:**

- *RSC Advance, Royal Society of Chemistry, UK, New Journal of Chemistry.*
- *Frontiers in Chemistry, Royal Society of Chemistry, UK.*
- *Scientific Reports, Nature Publishing Group.*
- *ACS Omega, American Chemical Society.*
- *International Journal of Wear, Elsevier.*
- *Journal of Materials Science, Elsevier.*
- *Materials Science and Engineering A, Elsevier.*
- *Materials Science and Engineering C, Elsevier.*
- *Ceramics International, Elsevier.*
- *Materials and Metallurgical Transactions A, Elsevier.*
- *Surface Engineering, Maney Publishers, UK.*
- *Materials and Manufacturing Process, Elsevier.*
- *International Journal of Applied Ceramic Technology, Wiley, USA.*
- *Journal of Mechanical Behaviour of Biomedical Materials, Elsevier.*
- *Thin Solid Films, Elsevier.*
- *Journal of the American Ceramic Society, American Ceramic Society, USA.*
- *Bulletin of Materials Science, SpringerLink, Springer, UK,*
- *Indian Journal of Physics, SpringerLink, Springer, UK.*
- *Transactions of the Indian Ceramic Society, Taylor & Francis.*
- *Bulletin of Materials Science, Indian Academy of Sciences, India*

➤ *and many others.....*

#### **Organizational Capability:**

- ❖ Member, Executive Council, 2004-10, & Secretary, Kolkata Chapter, Materials Research Society of India, (MRSI).
- ❖ Vice Chairperson, MRSI, Kolkata Chapter, 2006 to 2015.

#### **FDP Conducted:**

- ❖ I conducted About 80 online and offline FDP for the Faculty of Science during 2018-2021 at Manipal University Jaipur.

#### **Program Chair:**

- ❖ I worked as the Program Chair for more than 10 National/International Conferences at Manipal University Jaipur, MUJ (2018-2021).

#### **Mentoring:**

- I mentored about 30 Post Docs, Ph D scholars, Scientists and Technical Staff members during my tenure at CSIR-CGCRI, Kolkata (1986-2018).
- I mentored about 70 MUJ Faculty members who Earned GOI Sponsored Project worth More than 2.5 Crore INR (2018-2021) even during the Pandemic Years including the very first Industrial Project of the Physics Department at MUJ.
- I am currently mentoring about 15 Biyani Girls College Faculty for Project Applications, Conference, Workshop, Seminar Organizations etc.

#### **Research Supervision:**

- 🚩 PhD Thesis – 10 (10-Degrees Awarded, 3 Currently under co-supervision)
- 🚩 M. Tech. Thesis -30
- 🚩 B. Tech/B. E Thesis – 50

**Keynote Speaker** – I presented about 20 Keynote Addresses at various International/National conferences.

#### **Awards/Fellowships/ Recognition:**

- ❖ MRSI Medal, 25<sup>th</sup> AGM of MRSI at Bengaluru, Materials Research Society of India, Bangalore, 2014.
- ❖ Best Poster Paper Award, 2008, 53<sup>rd</sup> DAE Solid State Physics Symposium.
- ❖ Sir C V Raman Award, 2000, Acoustical Society of India.

- ❖ **Best Poster Paper Award**, 2000, Materials Research Society of India.
- ❖ **Visiting Scientist Fellowship Award**, 2000, Forschungszentrum, Juelich, Germany.
- ❖ **Outstanding Young Person Award** for Science and Innovation, Calcutta, 1997.
- ❖ **Lions Club of India Award**, 1996.
- ❖ **Best Poster Paper Prize**, Materials Research Society of India, India, 1995.
- ❖ **Australian Research Council Post-Doctoral Research Fellowship**, Govt. of Australia, 1990-1992.
- ❖ **Research Fellowship**, CSIR\*, Govt. of India, India, 1982-1986.
- ❖ **National Scholarship**, Govt. of India, 1978.
- ❖ **Merit Scholarship**, University of Kalyani, India, 1974
- ❖ \*CSIR: Council of Scientific & Industrial Research, Department of Science & Technology, Government of India

#### **Memberships of Professional Societies:**

1. Materials Research Society of India (Life Member), since 1995
2. Electron Microscope Society of India (Life Member), since 2000
3. Acoustical Society of India (Life Member), since 2000
4. Indian Physical Society (Life Member), since 2009
5. Indian Ceramic Society (Life Member), since 1995
6. Society for Materials Chemistry, since 2019

#### **Travel Abroad:**

- *Australia, 5-Nov-1990 to 4-Nov-1992, University of Sydney, To work as Guest Scientist at Dept. of Mechanical and Mechatronic Engineering, University of Sydney as a Australian Research Council Post-Doctoral Fellowship Awardee*

- *Germany (Federal Republic of), 18-Feb-2000 14-Aug-2000, Forshungszentrum, Juelich to work as Guest Scientist Fellowship Awardee at Forshungszentrum, Juelich*
- *Germany (February 22-28, 2010) to present an oral presentation along with another three poster papers at the International Conference “Nanobrücken : Hysitron European Workshop 2010” jointly organized by the INM – Leibniz Institute for New Materials and Hysitron, Inc. held at the INM campus in Saarbrücken, Germany, on February 25-26, 2010.*

*The aforementioned facts are true to the best of my belief.*

*A. K. Mukhopadhyay*

**Dr. Anoop Kumar Mukhopadhyay**

**Details of Publications:**

**Books: 3**

1. **Arjun Dey** and A. K. Mukhopadhyay, “**Nanoindentation of Brittle Solids**”, CRC Press, Taylor & Francis Group, 2014.

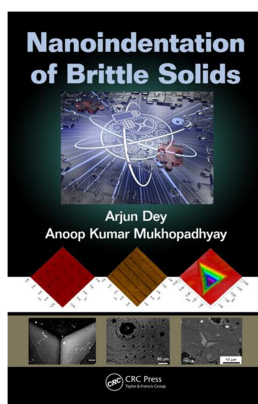
ISBN: 9781466596900 (Hardback)

ISBN: 9781138076532 (Paperback)

ISBN: 9781466596917 (e-book)

**Web-link:**

<https://www.crcpress.com/Nanoindentation-of-Brittle-Solids/Dey-Mukhopadhyay/p/book/9781138076532>



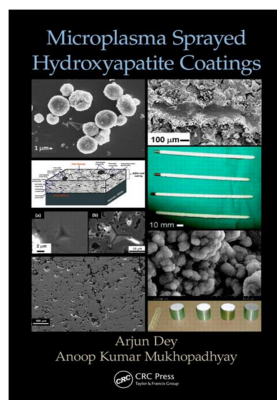
2. **Arjun Dey** and **A. K. Mukhopadhyay**, “**Microplasma Sprayed Hydroxyapatite Coatings**”, CRC Press, Taylor & Francis Group, 2015.

ISBN: 9781482250930 (Hardback) &

ISBN: 9781138748866 (Paperback),

**Web-link:**

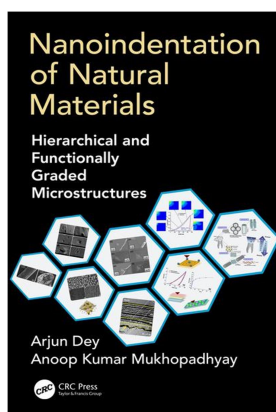
<https://www.crcpress.com/Microplasma-Sprayed-Hydroxyapatite-Coatings/Dey-Mukhopadhyay/p/book/9781138748866>



3. **Arjun Dey** and **A. K. Mukhopadhyay**, “**Nanoindentation of Natural Materials with Hierarchical and Functionally Graded Microstructure**”, CRC Press, Taylor & Francis Group, 2018.

ISBN: 9781498784054 (Hardback)

**Web-link:** <https://www.crcpress.com/Nanoindentation-of-Natural-Materials-Hierarchical-and-Functionally-Graded/Dey-Mukhopadhyay/p/book/9781498784054>



**Book Chapters: 5**

1. **A. K. Mukhopadhyay** and **K. K. Phani**, Mechanical Properties, in Handbook of Ceramics, Volume 3, Editor : S. Kumar, Kumar & Associates, Kolkata, pp.374-393, 1997.

2. **A. K. Mukhopadhyay**, High Temperature Mechanical Properties, in Handbook of Ceramics, Volume 3 , Editor : S. Kumar, Kumar & Associates, Kolkata, pp.397-420, 1997.
3. **A. K. Mukhopadhyay**, Tribology of Ceramics, Handbook of Ceramics, Volume 3, Editor : S. Kumar, Kumar & Associates, Kolkata, pp.392-396, 1997.
4. A. K. Gupta, Arjun Dey and **A. K. Mukhopadhyay**, “*Micromechanical and Finite Element Modeling for Composites*”, in ‘Computational Approaches to Materials Design: Theoretical and Practical Aspects’ Edited by S. Datta and J. Paulo Davim from IGI Global for release in the Advances in Chemical and Materials Engineering (ACME) Book Series, 2016. ”, DOI: 10.4018/978-1-5225-0290-6.ch005, ISBN: 9781522502906.  
**Web-link:**  
<http://www.igi-global.com/chapter/micromechanical-and-finite-element-modeling-for-composites/156828>
5. P. S. Das, S. Kakkar and A. K. Mukhopadhyay, “Microstructurally Engineered Materials for Environmental Applications” DOI: 10.1007/978-3-030-33774-2\_22, In book: Nanotechnology for Energy and Environmental Engineering (pp.511-528), Eds. Lalita Ledwani and Jitendra S Sangwai, Springer, March, 2020

**Journal Publications : 182**

**(1985) : (1)**

6. D. Chakraborty, **A. K. Mukhopadhyay** and J. Mukherjee, Influence of thermal quenching on surface fracture toughness and microhardness of Si<sub>3</sub>N<sub>4</sub>, Sialon and SiC, Rev. Int. Hautes Temp., 22,105, (1985).

**(1987) : (1)**

7. **A. K. Mukhopadhyay**, D. Chakraborty and J. Mukherjee, Fractographic study of sintered Si<sub>3</sub>N<sub>4</sub>, Sialon and RBSN, J. Mat. Sci. Lett. 6, 1198, (1987).

**(1988) : (5)**

8. D. Chakraborty and **A. K. Mukhopadhyay**, High temperature Young’s modulus of reaction bonded silicon nitride, liquid phase sintered silicon nitride and sialon, Ceram. Int., 14,127, (1988).
9. **A. K. Mukhopadhyay** and D. Chakraborty, High temperature fracture toughness and fractographic study of reaction sintered and liquid phase sintered sialon, Mat. Sci. Eng. A, 104, 215, (1988).
10. S.K.Datta, **A. K. Mukhopadhyay** and D. Chakraborty, Assessment of strength by Young’s Modulus and porosity - a critical evaluation, J. Am. Ceram. Soc., 71, 942, (1988).
11. **A. K. Mukhopadhyay** and D. Chakraborty, Influence of some factors on strength and fracture toughness of reaction bonded silicon nitride, Trans. Ind. Ceram. Soc. 47, 36 (1988).
12. S. K. Datta, **A. K. Mukhopadhyay** and D. Chakraborty, Assessment of strain through porosity of Si<sub>3</sub>N<sub>4</sub> ceramics, J. Mat. Sci. Lett., 7, 1119, (1988).

**(1989) : (3)**

13. D. Chakraborty and **A. K. Mukhopadhyay**, Creep of Sintered Silicon Nitride, Ceram. Int., 15, 237 (1989).
14. **A. K. Mukhopadhyay** and D. Chakraborty, Influence of some factors on Strength and Fracture Toughness of RBSN-Composite, Mat. Sci. Eng., A122, 173, (1989).



15. S. K. Datta, **A. K. Mukhopadhyay** and D. Chakraborty, Young's Modulus-Porosity Relationships in  $\text{Si}_3\text{N}_4$  - a Critical Evaluation, Am. Ceram. Soc. Bull., 68, 2098, (1989).  
(1990) : (5)
16. S. K. Datta, **A. K. Mukhopadhyay** and D. Chakraborty, Strength-Porosity Relationships in Silicon Nitride Ceramics, J. Mech. Behav. Mater. 3, 35, (1990).
17. **A. K. Mukhopadhyay** and D. Chakraborty, High Temperature Strength and Fractographic Study of Sialon, High Temp. Mater. Process., 9, 17, (1990).
18. D. Chakraborty and **A. K. Mukhopadhyay**, Creep of Reaction Sintered and Liquid Phase Sintered Sialon, J. Mech. Behav. Mater., 3, 43, (1990).
19. **A. K. Mukhopadhyay**, S. K. Datta and D. Chakraborty, On the Microhardness of Silicon Nitride and Sialon Ceramics, J. Eur. Ceram. Soc., 6, 303, (1990).  
(1991) : (2)
20. **A. K. Mukhopadhyay**, S. K. Datta and D. Chakraborty, Hardness of Silicon Nitride and Sialon, Ceram. Int., 17, 121, (1991).
21. A. P. Chatterjee, **A. K. Mukhopadhyay**, A.K. Chakraborty, R.N. Sasmal and S. K. Lahiri, Electrodeposition and Characterisation of Cuprous Oxide Thin Films, Mater. Lett., 11, 358, (1991).  
(1992) : (1)
22. A.K. Mukhopadhyay, A. P. Chatterjee, A. K. Chakraborty and S. K. Lahiri, Galvanostatic Deposition and Electrical Characterisation of Cuprous Oxide Thin Films, Thin Solid Films, 209, 92, (1992).  
1993 : (1)
23. **A. K. Mukhopadhyay** and Y. W. Mai, Grain Size Effects on abrasive Wear Mechanisms in Alumina, Wear, 162-164, 258, (1993).  
1994 : (1)
24. **A. K. Mukhopadhyay**, T. Liu, M. V Swain and Y-W. Mai, Deformation of Ceria Stabilised tetragonal Zirconia Ceramics in Scratch Experiments with a Sharp Indenter, J. Eur. Ceram. Soc., 13, 11, (1994).  
1996 : (2)
25. **A. K. Mukhopadhyay**, P. Mitra, D. Chattopadhyay and H.S. Maiti, Influences of fabrication techniques and doping on hydrogen sensitivity of zinc oxide sensors, J. Mat. Sci. Lett., 15, 431, (1996).
26. **A. K. Mukhopadhyay**, D. Basu, S. Mukherjee, et al., Ultrasonic velocity measurement for characterisation of porosity in sintered ceramics and metals, Trends in NDE Science and Technology - Proceedings of the 14th World Conference on NDT (14th WCNDT), Vols. 1-5, 803-806, (1996).  
(1997) : (4)
27. **A. K. Mukhopadhyay**, D. Chakraborty, M. V. Swain and Y. W. Mai, Scratch deformation Behaviour of Alumina under a Sharp Indenter, J. Eur. Ceram. Soc., 17, 91, (1997).
28. A. Chanda, **A. K. Mukhopadhyay**, D. Basu and S. Chatterjee, Wear and Friction Behaviour of UHMWPE-Alumina Combination for Total Hip Replacement, Ceram. Int., 23, 437, (1997).
29. A. Chanda, D. Basu, A. Dasgupta, S. Chattopadhyay and **A. K. Mukhopadhyay**, A New Parameter for Measuring Wear of Materials, J. Mat. Sci. Lett., 16, 1647, (1997).
30. J.C. Healy, A.J. Bushby, Y-W. Mai and **A. K. Mukhopadhyay**, Cyclic Fatigue of long and short cracks in Alumina, J. Mater. Sci. 32, 741, (1997).  
(1998) : (2)
31. **A. K. Mukhopadhyay** and K. K. Phani, Young's Modulus-Porosity Relations – An Analysis based on Minimum Contact Area Model, J. Mat. Sci., 33, 69, (1998).
32. **A. K. Mukhopadhyay**, P. Mitra and H. S. Maiti, A New Method to prepare Tin Dioxide Thin Film Gas Sensor, J. Mat. Sci. Lett, 17, 625, (1998).  
(1999) : (6)

33. P. Chatterjee, **A. K. Mukhopadhyay**, P. Mitra and H. S. Maiti, Chemically Deposited Zinc Oxide Thin Film Gas Sensor, J. Mat. Sci., 34, 4225, (1999).
34. **A. K. Mukhopadhyay** and A. Chanda, A New Wear Model, J. Mat. Sci. Lett. 18, 149, (1999).
35. **A. K. Mukhopadhyay**, Indentation Fatigue in Structural Ceramics - A Comparative Study, J. Mat. Sci. Lett. 18, 333, (1999).
36. D. Chakraborty, S. K. Datta and **A. K. Mukhopadhyay**, Influence of experimental parameters on fracture toughness of ceramics measured by different techniques, Trans. Ind. Ceram. Soc., 58, 131, (1999).
37. **A. K. Mukhopadhyay** and K. K. Phani, Ultrasonic Velocity - Porosity Relations - An Analysis based on Minimum Contact Area Model, J. Mater. Sci. Lett. 18, 1759, (1999).
38. **A. K. Mukhopadhyay**, S.K.Datta and D. Chakraborty, Fracture Toughness of Structural Ceramics, Ceram. Int. 25, 447, (1999).
- (2000) : (2)
39. **A. K. Mukhopadhyay**, P. Mitra, A. P. Chatterjee and H. S. Maiti, Tin Dioxide Thin Film Gas Sensor, Ceram. Int., 26, 123, (2000).
40. **A. K. Mukhopadhyay** and K. K. Phani, An analysis of Microstructural parameters in the Minimum Contact Area Model for Ultrasonic Velocity - Porosity Relation, J. Eur. Ceram. Soc., 20, 29, (2000).
- (2001) : (5)
41. **A. K. Mukhopadhyay**, Indentation Fatigue in Silicon Nitride, Alumina and Silicon Carbide Ceramics, Bull. Mater. Sci., 24, 105, (2001).
42. S. Mandal, A. Seal, A. K. Dey, S. Ghatak and **A. K. Mukhopadhyay**, Mechanical Characteristics of Microwave Sintered Silicon Carbide, Bull. Mater. Sci., 24, 121, (2001).
43. A.Seal, N. R. Bose, S. K. Dalui, **A. K. Mukhopadhyay**, K. K. Phani and H. S. Maiti, Mechanical Properties of Glass Polymer Multilayer Composites, Bull. Mater. Sci., 24, 197, (2001).
44. A.Seal, S. K. Dalui, M. Banerjee, **A. K. Mukhopadhyay** and K. K. Phani, Mechanical Properties of Very Thin Cover Slip Glass Disks, Bull. Mater. Sci., 24, 151, (2001).
45. **A. K. Mukhopadhyay**, M. Ray Chaudhury, A. Seal, S. K. Dalui, M. Banerjee and K. K. Phani, Mechanical Characterization of Microwave Sintered Zinc Oxide, Bull. Mater. Sci., 24, 125, (2001).
- (2003) : (1)
46. S. Das, **A. K. Mukhopadhyay**, S. Datta and D. Basu, Novel Method of developing oxide coating on aluminium using microwave heating, J. Mater. Sci. Lett. 22, 1635, (2003).
- (2005) : (3)
47. S. Ghosh, A. Guha, **A. K. Mukhopadhyay** and H. S. Maiti, Tape Cast Porous Nano Alumina Multilayer Composites, Trans. Ind. Ceram. Soc., 64, 101, (2005).
48. S. Ghosh, A. Guha, **A. K. Mukhopadhyay** and H. S. Maiti, Sintering and Hardness Behaviour of Nano Zirconia Tapes, Trans. Ind. Ceram. Soc., 64, 213, (2005).
49. S. Das, **A. K. Mukhopadhyay**, S. Datta and D. Basu, Microwave Sintering of Titania, Trans. Ind. Ceram. Soc., 64, 213, (2005).
- (2006) : (2)
50. S. Ghosh, A. Guha, K. M. Krishna, **A. K. Mukhopadhyay** and H. S. Maiti, Tape Cast Multilayer Composite of Nano Zirconia with High Toughness, Mater. Manuf. Process., 21, 662, (2006).
51. S. Das, **A. K. Mukhopadhyay**, S. Datta and D. Basu, Aluminium oxide coating by microwave processing, Trans. Ind. Ceram. Soc. 65, 105, (2006).
- (2007) : (4)

52. S. Senthil Kumar, **A. K. Mukhopadhyay**, R. N. Basu and H. S. Maiti, "Improvement of Mechanical Properties of Anode Supported Planar SOFC", J. Electrochem. Soc. Trans. 7, 533, (2007).
53. M. G. Maitra, M. Sinha, **A. K. Mukhopadhyay**, et al., "Ion-conductivity and Young's modulus of the polymer electrolyte PEO-ammonium perchlorate", Solid State Ionics, 178, 167, (2007).
54. P. Mitra and **A. K. Mukhopadhyay**, "ZnO thin film as methane sensor", Bull. Polish. Acad. Sci.-Tech. Sci., 55, 281, (2007).
55. S. Senthil Kumar, **A. K. Mukhopadhyay**, R. N. Basu and H. S. Maiti, "Solid Oxide Fuel Cells 10 (SOFC-X)", PTS 1 and 2, 7, 533, (2007).

**(2008) : (5)**

56. A. Dey, P. Dey, S. Datta, N. R. Bandyopadhyay, **A. K. Mukhopadhyay** and H. S. Maiti, "A New Theoretical Model for Development of Damage Tolerant Composites", Trans. Ind. Ceram. Soc., 67, 63, (2008).
57. A. Dey, P. Dey, S. Datta and **A. K. Mukhopadhyay**, "A New Model for Multilayer Ceramic Composites", Mater. Manuf. Process., 23, 513, (2008).
58. S. Das, D. Basu, S. Datta and **A. K. Mukhopadhyay**, "Crystallization of glass coating by microwave heating", Trans. Ind. Ceram. Soc., 67, 139, (2008).
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#### List of Projects implemented by Dr Anoop Kumar Mukhopadhyay

List of all projects that are supported by various funding agencies in which PI had actively participated (either as PI or as CI):

|   | Project Name   | Amount<br>(In Laks<br>INR)                                       | Sponsor   | Status                   |
|---|--|--|---|--------------------------|
| 1 | Development of laminated ceramic composites for structural applications (PI)                                   | 11.45  | DST (SERC)/<br>1999-2000 to 2001-<br>2002 ( 3yrs)   | Completed,<br>March 2002 |
| 2 | Joining of glass pieces by a novel fusion technique (CI)   | 14.41  | DST/1998-1999 to<br>2000-2001 (3 yrs)   | Completed,<br>March 2001 |
| 3 | Microstructural characterization of thermal barrier coating by indentation technique (CI)                      | CSIR-FZJ<br>Internatio<br>nal<br>Scientific<br>Collaborat<br>ion | CSIR, India and<br>Forschungszentrum,<br>Juelich (FZJ),<br>Germany;<br>2000-2001 to 2003-<br>2004 | Completed,<br>March 2004 |
| 4 | Nanostructured Multi-Layer Composites for Damage Tolerant Applications (PI)                                    | 19.98  | CSIR (CTSM Task<br>Force Project)/<br>2002-2003 to 2007-<br>2008                                  | Completed                |
| 5 | Near net shape manufacturing of bio-implants and engineering components from advanced ceramics and metals (CI) | 308  | CSIR (NNS Task<br>Force Project)/<br>2002-2003 to 2007-<br>2008                                   | Completed                |
| 6 | Micromechanical Characterization of Hydroxyapatite Coating for Metallic Implants (CI)                          | 20.82  | DST(SERC)/2006-07<br>to 2009-10   | Completed                |
| 7 | Development of Equation of State of Alumina and ZTA ceramics under shock loading (PI)                          | 21.96  | BRNS/2007-2010  | Completed                |
| 8 | Non-oxide ceramic based advance  | 1450   | CSIR Network  | Completed                |

|     |   |        |  |   |
|-----|---|--------|--|---|
|     | structural materials for Application in Armors (CI)   |        | Project, Project No. NWP 0029, 2007-2008 to 20012-2013   |   |
| 9   | Technology for Assessment and Refurbishment of Engineering Materials & Components (TAREMAC), Activity II : Minimally Invasive and Miniature Specimen Techniques : Sub-Activity : Indentation Technique for Ceramic Materials (PI)     | 80     | CSIR Network Project under XIth 5 Year Plan, Project No. NWP 0027, 2007-2008 to 20012-2013   | Completed   |
| 10  | Renovation of Mechanical Testing Facility at CGCRI (PI)   | 88     | CSIR Network Project entitled Supra Institutional Project (Project No. SIP 0023) : under Xith 5 Year Plan, 2007-2008 to 20012-2013 | Completed, 31 March, 2014 (after extension from FY 2012-13) |
| 11  | Evaluation of Mechanical Properties (PI)  | 10     | In-house Infrastructural Project (Project No. STS 0020)  | Completed   |
| 12  | Nanomechanical Characterization of Carbon Carbon Composites (PI)  | 17.20  | VSSC, No. ISRO (Project GAP 0235)  | Completed   |
| 13  | Development for ITO foam for stealth application (PI)   | 20     | DRDO (Project GAP 0613)  | Completed   |
| 14  | Ecofriendly Geopolymers from Clay based minerals under theme area of "Specialty Materials Based on Engineered Clays." (PI)  | 63.5   | CSIR   | Completed   |
| 15. | Ceramic materials for Membrane, Energy, and Structural Armour applications (CERMESA), Task 3 : Advanced composite armour for protection against medium caliber threat, PI: Dr P K Das, CSIR-CGCRI, Team Member Dr A. K. Mukhopadhyay, | 6800   | CSIR   | Completed   |
| 16  | Nanomechanical Characterization of human hair (PI)  | 9.99   | CavinKare (SSP 0219)   | Completed   |
| 17  | Development of Novel Biomedical Implants with Enhanced Reliability  | 33.396 | DST-SERB (GAP 0240)  | Completed   |
| 18  | Studies on Vanadium Oxide based Thin Films Developed By Dip/Spin Coating Techniques for Spacecraft Thermal Control Applications   | 21.41  | ISRO (RESPOND) GAP 0245  | Completed   |

**Details of Research Projects being implemented/ completed/ submitted by the Investigator(s) including Investigator(s) Name & Institute**

Completed Projects by Dr Anoop Kumar Mukhopadhyay

Project No. 1: Development of laminated ceramic composites for structural applications PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, Co-PI: Dr K K Phani, Sponsor: DST(SERC), Amount: Rs. 11.45 Laks, Completed, March 2002.

This project led to development of tough multilayer ceramic Composites (MLC) fabricated by Tape Casting Technique. The alumina – ZTA MLC had high failure energy of 25 –50 KJm<sup>-3</sup>.

Project No. 2: Joining of glass pieces by a novel fusion technique, PI: Dr K K Phani, CSIR-CGCRI, CI : Dr A. K. Mukhopadhyay, Sponsor: DST, Amount: 14.41 Laks, Completed, March 2001.

This project successfully developed a novel fusion technique for joining of optical glass cullets.

Project No. 3: Microstructural characterization of thermal barrier coating by indentation technique (CI), PI: Dr K K Phani, CSIR-CGCRI, CI : Dr A. K. Mukhopadhyay, CSIR-CGCRI and FZJ, Germany, Sponsor: CSIR-FZJ International Scientific Collaboration, Completed, March 2004.

This International Scientific collaboration project between Forschungszentrum, Juelich, Germany and CGCRI, Kolkata established several novel variants of the depth sensitive indentation (DSI) technique for characterization of ceramic thermal barrier coatings (TBC).

Project No. 4: Nanostructured Multi-Layer Composites for Damage Tolerant Applications PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, Co-PI: Dr K K Phani, Sponsor: CSIR Amount: Rs. 19.98 Laks, Completed, March 2007.

This completed project developed tape cast nano structured zirconia based multilayer composites with failure energy (238.97 KJm<sup>-3</sup>) more than two times higher than that of the single tape, high bi-axial flexural strength ( $\approx$  650 MPa), high hardness ( $\approx$ 13 GPa at 49 N) and a indentation fracture toughness ( $\approx$  5 MPa $\sqrt{m}$ ) value nearly 1.8 times as high as that of the single tape.

Project No. 5: Near net shape manufacturing of bio-implants and engineering components from advanced ceramics and metals, PI: Dr D Basu, CSIR-CGCRI, CI : Dr A. K. Mukhopadhyay, Sponsor: CSIR, Amount: 308 Laks, Completed, March 2007.

This completed collaborative project between CMERI, Durgapur and CGCRI, Kolkata developed and established the Near Net Shape (NNS) manufacturing of “tailored” bio-ceramics based medical implants using for the first time in the country a combination of Medical Imaging, 3D Scanning and Selective Laser Sintering (SLS) as well as RP-RT-Investment Casting methods.

Project No. 6: Micromechanical Characterization of Hydroxyapatite Coated Metallic Implants, PI: Dr D Basu, CSIR-CGCRI, CI : Dr A. K. Mukhopadhyay, Sponsor: DST(SERC), Amount: 20.82 Laks, Completed, March 2010.

In this completed project a new approach was proposed to apply depth sensitive indentation (DSI) technique to extract short-range and long-range residual stresses at different size scales, Young's modulus and hardness etc. of plasma sprayed and bio-mimetic HAP coatings on metallic implants. Fifteen implants with optimized coatings were finally prepared from each route for in-vivo human trials and the dependence of micromechanical properties on dissolution rate etc.

Project No. 7: Development of Equation of State of Alumina and ZTA ceramics under shock loading, PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, Co-PI: Dr K D Joshi, BARC, Sponsor: BRNS, DAE, Amount: Rs. 21.96 Laks, Completed, March 2010.

This completed project most successfully initiated shock physics research in ceramics for the first time in the country and developed Equation of State for Alumina ceramics under shock loading.

Project No. 8: Non-oxide ceramic based advance structural materials for Application in Armors, PI: Dr S. Biswas, CSIR-CGCRI, CI : Dr A. K. Mukhopadhyay, Sponsor: CSIR, Amount: 1450 Laks, Completed, March 2013.

This completed project developed Ceramic Armor of desired size for the requirement of user agencies in the country, but due to the NDA between DOD and CSIR-CGCRI and the very strategic nature of the project, the details of scientific and technological achievements are kept withheld from public domain.

Project No. 9: Technology for Assessment & Refurbishment of Engineering Materials & Components (TAREMaC), Activity II: Minimally Invasive and Miniature Specimen Techniques: Sub-Activity: Indentation Technique for Ceramic Materials, PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, Sponsor: CSIR, Amount: 80 Laks, Completed, March 2013.

This completed project achieved microstructure-mechanical property correlation with special emphasis on nanoindentation based techniques and has established at CSIR-CGCRI the first dedicated

nanoindentation laboratory in the country, especially dedicated to brittle solids like glass and ceramics.

Project No. 10: Renovation of Mechanical Testing Facility at CGCRI, PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, Sponsor: CSIR, Amount: 88 Laks, Completed, March 2013.

This completed project achieved the modernization of the existing mechanical testing capability of the Mechanical Property Evaluation Section at CGCRI.

Project No. 11: Evaluation of Mechanical Properties, PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, Sponsor: CSIR-CGCRI, Amount: 10 Laks, Completed, March 2012.

This completed project dealt with evaluation of all relevant mechanical properties of glass, ceramics, refractories, structural ceramics, ceramic composites, PMCs, epoxy resins, polymers, MMCs, MLCCs, bio-ceramics, Ceramic Coatings and Thin Films for both in-house projects, R&D Projects and external clients from academia and industries.

Project No 12: Nanomechanical characterization of carbon carbon composites”, PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, Sponsor: ISRO, Amount: 17.20 Laks, Completed in March 2015.

This ongoing project achieved the nanomechanical characterization of carbon carbon composites which are developed by ISRO themselves for future Indian spacecrafts. Due to the very strategic nature of the project, the details of scientific and technological achievements are kept withheld from public domain.

Project No 13: Development of ITO Foam Coatings for Stealth applications, PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, Sponsor: DRDO, Amount: 20 Laks, Completed in March 2017.

This completed project achieved the development of appropriately doped ITO powders for preparation of ITO Foam Coatings for Stealth applications. The coating development and characterizations are now in advanced stage of completion at CSIR-CGCRI. Due to the very strategic nature of the project, the details of scientific and technological achievements are kept withheld from public domain.

Project No. 14: Development of Advanced Clay based Geo-Polymers for Structural applications, PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, CI: Dr S K Ghosh, Sponsor: CSIR, Amount: 63.5 Laks.

This completed project achieved preparation of geopolymers blocks with promising mechanical properties e.g., compressive strength of as high as ~25 MPa after 7 days. The nanohardness and Young's modulus values were found to be ~0.25 GPa and ~12.77 GPa, respectively. Completed in March 2017.

Project No. 15: Ceramic materials for Membrane, Energy, and Structural Armour applications (CERMESA), Task 3 : Advanced composite armour for protection against medium caliber threat, PI: Dr P K Das, CSIR-CGCRI, Team Member Dr A. K. Mukhopadhyay, Sponsor: CSIR, Amount: 6800 Laks, Completed in March 2017.

This project developed the Advanced Composite Armour of desired size for the requirement of user agencies in the country, for protection against medium caliber threat; but, due to the NDA between DOD and CSIR-CGCRI and the very strategic nature of the project, the details of scientific and technological achievements are kept withheld from public domain.

Project No. 16: Nanomechanical Characterization of human hair, PI: Dr A. K. Mukhopadhyay, CSIR-CGCRI, CI: S D Acharya, Sponsor: CavinKare Pvt. Ltd., Chennai, India, Amount: 9.99 Laks, Ongoing.

Human hair can be a good model to study the role of various structural and chemical components responsible for the mechanical strength for composite biological fibers as it is actually a nanocomposite biological fiber with well characterized structures. Completed in March 2015.

Project No. 17: Development of Novel Biomedical Implants with Enhanced Reliability, CSIR-CGCRI, CI: Dr V K Balla, Dr B. Kundu and 5 Others from CSIR-CGCRI, Sponsor: DST, Amount : Rs. 33.396 Laks,

This project developed Novel Biomedical Implants with Enhanced Reliability by surface engineering of SS306L and Ti6Al4V alloys through a combined approach of plasma nitriding and multilayer PVD coatings to provide both hardness and surface fracture toughness. Completed in March 2018.

Project No. 18: Studies on Vanadium Oxide based Thin Films Developed By Dip/Spin Coating Techniques for Spacecraft Thermal Control Applications, CSIR-CGCRI, CI: Dr A Dey, Dr N. Sridhara from ISAC, ISRO, Sponsor: ISRO (RESPOND), Amount : Rs. 21.41 Laks, This project

developed Vanadium Oxide based Thin Films by Dip/Spin Coating Techniques for Spacecraft Thermal Control Applications. The Project is completed in June, 2018.