# BIODATA

**SHARAD CHANDRA SHARMA,** FIICer, FIIM, FNAE
**Former Associate Director,** R&D/ **Outstanding Scientist**
(Officiating Director from time time)
Vikram Sarabhai Space Centre, ISRO, Trivandrum-695022

**Former Professor**, Dept. of Mech. & Auto. Engg.
School of Engg. and Tech., Christ (Deemed to be University), Bangalore

**Educational Qualifications**

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| B.E. | Materials and Metallurgical Engg.<br>University of Roorkee, Roorkee |
| M.Sc.(Engg.) | Materials Science<br>Indian Institute of Science, Bangalore |
| Ph.D. | Faculty of Science, University of Kerala, Trivandrum<br>Thesis title: A Study on the Development of Carbon foam based Thermal Protection System for Reusable Launch Vehicle |

- **Professional Experience : ANNEXURE-I**
- **Research Experience/Published Work : ANNEXURE-II**
- **Supervision of PhD Projects & Examination of PhD Theses: ANNEXURE-III**
- **Patents : ANNEXURE-IV**
- **Professional Recognition/Awards/Honours : ANNEXURE-V**
- **Invited Papers/Keynote Lectures : ANNEXURE-VI**
- **Papers co-authored/authored and presented in National/ International Conferences/Seminars/Workshops : ANNEXURE-VII**
- **Major Achievements: ANNEXURE-VIII**
- **Technical Infrastructure Build-up : ANNEXURE-IX**
- **Technology Transfers to Industries : ANNEXURE-X**
- **Techno Managerial Responsibilities held : ANNEXURE-XI**
- **Contribution to the Professional Field : ANNEXURE-XII**
- **Association with Indian Institute of Space Science & Technology : ANNEXURE-XIII**

ANNEXURE-I

# Professional Experience

- Joined Vikram Sarabhai Space Centre(VSSC) in 1982 and worked extensively on physical metallurgy, heatreatment and welding of high temperature superalloys, ultra high strength maraging steels, High Strength Low Alloy (HSLA) steels, and special stainless grades of steels for Indian space programme.

- Carried out extensive research on 'Disorder entrapment in NiAl based intermetallics for enhancing their deformation characteristics and use at high temperature and 'Development of microstructures in Fe-Al system under micro-g conditions', as **Visiting Scientist** at **German Aerospace Establishment, Cologne, Germany** from Jan. 1992 to Oct. 1992.

- Designated as the **Project Leader, Special Purpose Materials Development Project** in 1998 and under this assignment, successfully led the indigenous development programme for a series of import-critical special purpose alloys for inertial and navigation systems of satellite launch vehicles and satellites.

- Guided the development of powder metallurgy based products, ferrous & non-ferrous alloys and special foundry and investment casting activities for Indian space programme, as **Head, Materials Processing Division** and subsequently **Head, Special Materials Division** of Materials and Metallurgy Group (MMG), VSSC from 2005 to 2011,

- Concurrent to the above responsibilities, spearheaded the efforts spanning over years to nurture the exotic field of micro-g materials processing in the country first as **Project Manager** and subsequently as **Dy. Project Director**, **Micro-g Scientific Payloads, Space Capsule Recovery Experiment Project** (SRE) of Indian Space Research Organization (ISRO). In addition to my own μg experiments, also coordinated various space experiments from India and abroad,

- Keeping pace with the advanced space programmes world over, ISRO conceived and successfully implemented one of its most formidable projects viz. Reusable

Launch Vehicle–Technology Demonstrator (RLV-TD) wherein thermal protection of the space vehicle during atmospheric reentry is the most critical phase of the whole mission. As **Associate Project Director (TPS), RLV-TD Project**, led the development of silica tiles, flexible surface insulation and other high temperature materials for RLV programme.

- As **Group Director, Materials & Metallurgy Group** of VSSC from 2011 to 2016, was responsible for the development and supply of a range of ferrous and nonferrous materials/components and process-technologies for on-going as well as emerging programmes of ISRO, including performance-critical powder metallurgy products, complex-shaped investment casting, ignition resistance coatings, brazing technologies, special titanium alloys and materials processing and characterization support for cryogenic engine, semi-cryo engine and other projects.

- From 2016 to 2020, as **Dy. Director, Propellants, Polymers, Chemicals and Materials (PCM) Entity**, successfully led the important technical activities of PCM Entity in the areas of energy systems including development, qualification and delivery of Li-ion cells for launch vehicle and satellite projects, polymeric products such as modified foam insulation for cryo tanks of C-25 stage in GSLV MkIII and polyimide pipes for cryo stages in GSLV MkIII & GSLV, lab-scale development and scaling up of high burn rate propellant (PEDCEM-86) upto 1200 kg level for Crew Escape System, environment friendly asbestos-free PEDIN C inhibition system for solid motors, igniter grains for Crew Jettisoning motor/Low altitude Escape motor for Gaganyaan, etc. Also ensured timely supply of more than fifty schedule-critical project-deliverables from PCM Entity to LVs and satellite missions including HTPB, PF 106 and PF 108 resins, thermal control films & paints, igniter grains, a variety of adhesives & sealants, TPS coating materials, nozzle enclosures, thermal screens, etc. Technology of eight in-house developed PCM products was transferred to industries.

- Steered Indigenisation of Space Materials (ISM), an inter-centre programme of ISRO from 2016 to 2019, as **Chairman, ISM Steering Committee**. Major thrust was put on indigenous development of new strategic materials such as electronic ceramics, powder metallurgy products, coating techniques, special rubber and polymeric products, critical requirements in satellite area such as Au plated Mo mesh for large aperture unfurlable space antenna, complex-profile based extruded Al alloy heat pipes etc.

- As **Associate Director, R&D, VSSC** since February 01, 2020 till superannuation, focussed major efforts towards catalysing research environment and synergizing

R&D activities in VSSC. As Chairman of the VSSC Research Forum (VRF) which is constituted for the first time in the Centre,guiding and steering entire range of research process in VSSC. As Chairman, VSSC Standing Committee for Review of Adv. R&D and TDP Activities, putting in major efforts for steering 779 activities of the Centre in this area, in terms of meeting their technological objectives and time-lines.

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# Research Experience/Published Work

❖ **Guest Editor, Special Issue** of **Transactions of the Indian National Academy of Engineering on "Advanced Thermo Structural Materials and Thermal Protection Systems" (ADTHERM-'20),** published by **Springer Nature, https://doiorg/10.1007/s41403-021-00220-3**

My experience in carrying out and guiding research is mainly in the area of materials science and technology. Details are as follows:

**Solidification behaviour of alloys under reduced gravity environment**

- Demonstration of feasibility of introducing disorder during solidification in the highly ordered crystal structure of $Ni_3Al$, a highly brittle low density material for high temperature applications, in order to make them ductile for practical use.

- Study of movement of solidification front and microstructure development in Al-Fe alloy during non-equilibrium solidification

- Modification of metallurgical features in Sn-Sb alloy using rapid solidification technique.

- Development of morphological features in Al-W composite under one-g reference processing environment

- Study of role of heat-transfer mechanisms and consequent modes of solidification on microstructure development employing drop-tube and atomization techniques.

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1) **S.C. Sharma,** D.M.Herlach and P.P.Sinha, "Entrapment of Disorder in Drop-Tube Processed Ni3Al" - Scripta Metallurgica et Materialia, Vol.28, No.11, June 1993, pp 1365-1370.
2) **S.C. Sharma,** T. Volkmann and D.M. Herlach, "Microstructural Development in Drop-tube Solidified Al-3.6wt% Fe Droplets : An Analysis" - Materials Science and Engineering, A171 (1993), pp 169-173.
3) **S.C. Sharma** and D.M.Herlach, "Salient Features of Microstructural Development in Drop-Tube Processed Al-3.6 wt% Fe Droplets" - Microgravity Science and Technology (Germany), Vol.V, No.3, 1992, pp 145-150
4) **S.C. Sharma** and P.P. Sinha, "Role of Heat Transfer Mechanisms on the Microstructure

Development : Drop-tube vis-a-vis Atomization", Proc. of Int. Conf. on Solidification Science and Processing : Outlook for 21st Century**,** ed. B.K Dhindaw et al, Science Publishers, Inc., Enfield, NH, USA, 2001, p213.

5) **S.C. Sharma,** P.R.Narayanan, P.P.Sinha and K.V.Nagarajan, "Processing characteristics of Al/W composite under one-g conditions" - Journal of Materials Science, 29 (1994), pp 5719-5724.

6) **S.C. Sharma,** P.Ramesh Narayanan, P. Srinivasa Rao and S.T.G. Sampath Kumar, "Drop Experiment on Sn-10wt% Sb Alloy: Metallographic Features" - Trans. Indian Institute of Metals, Vol.45, No.1, 1992, pp 45-50.

7) **S.C. Sharma,"**Micro-g Processing Research : A Quest for the Frontiers",inEvolution of Materials Research for Indian Space Programmes, ed. KS Nair & PP Sinha, Pub. ISRO HQ, 2009, pp 303-12.

8) **S.C. Sharma**, K. Chattopadhyay and P.P. Sinha "The First Indian Materials Processing Experiments in Space aboard ISRO's Orbital Micro-g Platform" – Procd. International Conf. "Frontiers in Metallurgy and Materials Technology – FMMT-09" Hyderabad, Jan. 2009.

9) **S.C. Sharma**, N.C. Bhat and A. Subramoniam "Microgravity Experiments carried out aboard First Mission of ISRO's Recoverable Space Capsule" Procd. 58thInternational Astronautical Federation Congress, Hyderabad, Oct 24-28, 2007, Paper No. IAC-07-A2-3.01.

10) **S.C. Sharma**, "Intermetallic, Nucleation and Structural Development in Undercooled State" - Proc. of DLR - Ruhr Univ., Bochum (Germany) Summer School, Cologne, Germany, July 1992, No.DLR:IB-333-92/, pp 89-99.

11) **S.C. Sharma** and B.K.Sarkar, "Design Considerations for the Melting Furnace for Microgravity Experiment on Sn-Sb Alloy and W-dispersed Sb/Al Composites" - Proc. 39th Congress of Int. Astronautical Federation, Bangalore, India, Oct. 8-15, 1988 (IAF 88-373).

## Research and development of ferrous and non-ferrous alloys for space applications

- Study of heat treatment parameters on the forming behaviour of flat products of Ni based superalloy Inconel 718

- Tensile behaviour of cryogenic engine thrust chamber alloy Cu-Zr-Ti under varying temperatures and rates of strain and role of hot working on recrystallization in advanced thrust chamber alloy Cu-Cr-Nb based on dispersion strengthening .

- Development of microstructure and other morphological features in high specific strength Al-Cu-Li alloy AA 2195 for cryo tankage application

- Effect of cyclic stresses on mechanical properties of stainless-steel SS 304 under high temperature conditions.

- Improvement of mechanical properties of stainless variant of maraging steel by optimising heat treatment parameters.

- Study on effect of multi-pass warm rolling on development of texture, microstructure and properties in Ti-6Al-4V alloys

- Metallurgical study on evolution and morphology of defects in weld joints of maraging steel motor casings.

- Optimization of process parameters for realization of Ti-6Al-4V wire rods for fasteners.

- Studies on scale-up of Al-Cu-Li alloy AA 2195 through vacuum induction melting technique for application in cryo-tankages

- Effect of heat treatment parameters on property and microstructure development in 12Cr-10Ni-0.25Ti-0.7Mo stainless steel

- Development of ultra-fine grained (ULF) Mg alloy AZ31 using multi-pass warm rolling technique.

- Process technology development for Al-Cu-Mg alloy V65 bars and wires for rivet applications.

- Study on ultrasonic quality enhancement in continuously cast Al alloy 2014 ingot.

- Homogenization studies on AL alloy AA 2014 direct-chill cast billets employing calorimetry and metallographic techniques.

- Development of tungsten inert gas arc welding technology for plates of ultra-high strength 18Ni 250 grade maraging steel.

- Diagnostic heat treatment study on Cu-1.9Be-0.2Co alloy for torsion bar applications in inertial navigation system.

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1) K.S. Prasad, S.K. Panda, S.K. Kar, S.V.S. Narayana Murty and **S.C. Sharma**, "Effect of solution treatment on the formability and part performance of Inconel 718 sheet material", Advances in Materials & Processing Technologies, https://doi.org/ 10.1080/ 2374068X.2018.1510678.

2) K.S. Prasad, S.K. Panda, S.K. Kar, S.V.S. Narayana Murty and **S.C. Sharma**, "Effect of solution treatrment on deep drawability of Inconel 718 sheets : Experimental analysis and metallurgical characterization", Material Science and Engineering A, https://doi.org/10.1016/j.msea.2018.04.110

3) G. Sudarshana Rao, V.M.J. Sharma, S.G.S. Raman, M. Amruth, P.Ramesh Narayanan, **S.C. Sharma**, P.V. Venkitakrishnan, "Effects of temperature and strain rate on tensile properties of Cu-Zr-Ti alloy", Material Science & Engineering A, 668 (2016), pp97-104.

4) A.K. Shukla, S.V.S. Narayana Murty, **S.C. Sharma** and K. Mondal, "The serrated flow and recrystallization in dispersion hardened Cu-Cr-Nb alloy during hot deformation", Material Science & Engineering. A, 673 (2016), pp 135-140.

5) Niraj Nayan, Nilesh P. Gurao, S.V.S.N. Murty, A. K. Jha, B. Pant, **S. C. Sharma**, K. M. George, "Microstructure and micro-texture evolution during large strain deformation of an aluminium-copper-lithium alloy AA2195", Materials and Design 65(295) pp 862 -868.

6) G.S. Rao, J. Srinath, P. Ramesh Narayanan, **S.C. Sharma,** "Thermomechanical Fatigue Behavoiur of SS304", Trans Indian Inst Met, 23rd Nov. 2015 (DOI 10.1007/s12666-015-2)

*7)* Ankit Sharma, Alok Agarwal, Mayukh Acharya, Govind, and **S.C. Sharma**, "Optimization of Aging Cycle of Stainless Maraging Steel using Dilatometric and Differential Scanning Calorimetric Analysis to improve its Strength", Materials Science Forum, 830-831(2015)pp 147-150.

8) S.V.S.N. Murty, Niraj Nayan, Pankaj Kumar, P. Ramesh Narayanan, **S.C. Sharma**, Koshy M. George, "Microstructure-texture-mechanical properties relationship in multi-pass warm rolled Ti-6Al-4V Alloys", Materials Sci. & Engg. A 589(2014) 174-181.

9) A.K.Shukla, S.V.S.N.Murty, **S.C. Sharma**, K.Mondal, "Aging behaviour and microstructural stability of a Cu-8Cr-4Nb alloy", J. Alloys and Compounds 590(2014) 514-525.

10) S.V.S.N. Murty, G.S.Rao, A. Venugopal, **S.C. Sharma,** K.M. George, "Metallurgical Analysis of Defects in the Weld Joints of Large-Sized Maraging Steel Rocket Motor Casing", Metallogr. Microstruct. Anal. (2014)3:443-447 (Vol.3, No.6, Dec.2014).

11) S. V. S. N. Murthy, N. Nayan, K.V.A. Chakravarthy, **S. C. Sharma**, P. P. Sinha, " Development of Ti-6Al-4v wire rods for fasten Application", Metal Science and Heat treatment, 56(1-2), 41-44, 2014.

12) Niraj Nayan, S.V.S. Narayana Murty, Abhay. K. Jha, Bhanu Pant, **S.C. Sharma** and Koshy M George "Processing and characterization of Al-Cu-Li alloy AA2195 undergoing scale up production through vacuum induction melting technique" Materials Science and Engineering: A,Volume 576, 1 August 2013, Pages 21-28**.**

*13)* S. Chenna Krishna, J. Srinath, A.K. Jha, B. Pant, **S.C. Sharma**, K.M. George, "Effect of Heat Treatment on Microstructure and Mechanical Properties of 12 Cr-10Ni-0.25Ti-0.7Mo Stainless Steel**,** J. Metallography, Microstructure and Analysis**,** Vol. 2, No. 2, , June 2013,

14) N. Nayan, S. V. S. N. Murty, **S. C. Sharma**, K. Sreekumar and P. P. Sinha, "Processing and Characterization of Al-Cu-Li Alloy AA2195", Materials Science Forum, 710, (2012) 119-124.

15) N. Nayan, S. V. S. N. Murty, **S. C. Sharma**, K. Sreekumar and P. P. Sinha, "Processing and Characterization of AA2195 Al-Cu-Li Alloy Bars Processed through Vacuum Induction Melting and Caliber Rolling", Materials Science Forum, 710, (2012) 125-131.

16) N. Nayan, S. V. S. N. Murty, A. K. Jha, **S. C. Sharma**, K. Sreekumar and P. P. Sinha **"**Processing of Al-Cu-Mg Alloy (V65 Grade) Bars as Feedstock for Wire Drawing", Materials Science Forum, 710, (2012)167-173.

17) N. Nayan, S. V. S. N. Murty, **S. C. Sharma** and P. P. Sinha, **"**Processing of V65 Aluminium Alloy Wires Processed from Hot and Warm Rolled Rods for Rivet Applications", Materials Science Forum, 710, (2012)174-179.

18) N. Nayan, S. V. S. N. Murty, **S. C. Sharma** and P. P. Sinha,**"**Processing and Characterization of Al-Cu-Mg Alloy Rivets for Aerospace Applications", N. Nayan, S. V. S. N. Murty, A. Agarwal, S. C. Sharma and P. P. Sinha, Materials Science Forum, 710, (2012)180-185.

19) S. V. S. N. Murty, Niraj Nayan, **S. C. Sharma**, K. Sreekumar and P. P. Sinha "Development of Ultrafine–grained magnesium alloy AZ31 by multi – pass warm rolling", Metal Science and Heat Treatment, Vol.53, Nos.5-(May-June, 2011)270-273

20) N. Nayan, S. V. S. N. Murty, **S. C. Sharma**, K. Sreekumar and P. P. Sinha "Optimization of Homogenization Parameters of Al-Cu-Li Alloy Cast Ingots Using Calorimetry and Metallographic Techniques", Materials Science Forum, 710, (2012)557-562.

21) Niraj Nayan, Alok Agarwal, Govind, A. K. Jha, P. Ramesh Narayanan, K. **S.C. Sharma**, Sreekumar and M. C. Mittal, "A Study of Continuously cast ingots of Aluminium alloy AA2014 with increased ultrasonic characteristic", Metal Science and Heat Treatment, Vol.53, Nos.7-8, November, 2011.

22) D. S. Kurkure, B. G. Naik. S. C. Sharma, Priyadarshan, P. Subramanian and P. C. Thomas, "Design, Processing and Fabrication Methodology of Beryllium based Alloy for Advanced Mechanisms of Space Crafts", Procd. National Conf. **"**Space Transportation Systems: Challenges and Opportunities**"** INAE, Dec. 2011, Trivandrum, (TP: 049)

23) Niraj Nayan, SVS Narayana Murthy, Govind, **S.C. Sharma**, P.P. Sinha, "Homogenisation studies on Aluminium alloy AA2014DC cast billets using calorimetery and metallographic techniques**",**Journal of Metals Science and Heat Treatment Vol.29,No.9. pp1033-09, 2009.

24) T. Venkateswaran, P Muneswar, S.K. Manwatkar, A. Shanmugavel, D. Sivakumar and **S.C. Sharma**, "Effect of Accumulative Roll Bonding on Microstructure and Properties of AA1100 and AA6351 Aluminum Alloy Sheets", Procd. of "Light Alloys in Aerospace Systems-NAMS 2007"**,** Trivandrum, December 2007.

25) P. Muneshwar, S.K. Singh, B. Pant, **S.C. Sharma** and M.C. Mittal, "Advanced Processing Techniques for Titanium Base Alloys and its Aluminides for Space Applications", Trans. Indian Int. Met, ***Vol.61,*** Nos.2-3, April-June 2008, pp.77-85 (TP2185).

26) S.V.S. Narayana Murty, Niraj Nayan, **S.C. Sharma**, M.C. Mittal and P.P. Sinha, "Development of ultrafine-grained magnesium alloy AZ31 by multipass warm rolling", J. of Metals Science and Heatreatment**,** Vol.29,No.3. pp233-09, 2009

27) M.R. Suresh, R. Suresh Kumar, **S.C. Sharma** and P.P. Sinha, "Indigenous Development of HSLA Steel for Space Applications" - Proc. National Seminar "Emerging Technologies and Indigenisation in Aerospace", Kanpur, India, Dec.1-2, 1995, Vol.I pp 149-161.

28) B.R.Ghosh, **S.C.Sharma**, M.C. Mittal and K.V.Nagarajan, "Processing of Cu-1.9Be-0.2Co alloy torsion bars for space applications: A diagnostic heat treatment study" - Journal of Heat Treating, Vol.17, No.2, 1989, pp 129-133 .

29) B.R.Ghosh, M.S.P.Murthy, **S.C. Sharma**, M.C.Mittal and K.V.Nagarajan, "TIG Welding Technology of 7mm thick 18 Ni 250 grade Maraging Steel Plates for Space Applications" - Trans. Indian Institute of Metals, Vol.40, No.3, 1987, pp 227-234.

30) **S.C. Sharma**, B.R.Ghosh, M.C.Mittal and K.V.Nagarajan, "Technological Advances in Inert Gas Shielded Arc Welding Process - An Overview", Indian Welding Journal, Oct. 1987, pp 262-70.

## Development and application of advanced ceramics

- A wide range of studies for the development of near-zero thermal expansion transparent lithium alumino silicate (LAS) glass ceramics for optimal mirror structures. Studies included role of microwave hybrid treatment on crystallisation behaviour of LAS, effect of additives on microstructure evolution during bulk sintering and detailed characterisation with respect to compositional, physical and functional characterisation of the glass ceramics

- Study of permittivities of silica beads and aerogels with ultra-low dielectric properties and development work on barium-titanite based patch antenna substrates.

- Effect of compositional variations on the evolution of microstructure and properties in machinable glass cearmics.

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1) C. Venkateswaran, H Sreemoolanadhan, **S.C. Sharma,** Bhanu Pant, V.S. Chauhan & R. Vaish, "Processing of $Li_2O$-$Al_2O_3$-$SiO_2$(LAS) glass ceramic with and without $P_2O_5$ through bulk and sintering routes", *J. of Non-Crystalline Solids*, accepted (Ref. NOC-D-20-00683)

2) C. Venkateswaran, **S.C. Sharma**, Bhanu Pant, V.S. Chauhan, Rahul Vaish, "Crystallisation studies on site saturated lithium aluminosilicate (LAS) glass", Thermochimica Acta, 679 (2019), 178311.

3) C. Venkateswaran, **S.C. Sharma**, V.S. Chauhan and Rahul Vaish, "Near-zero thermal expansion transparent lithium aluminosilicate glass ceramic by microwave hybrid treatment", J. American Ceramic Society, 2018,101, pp 140-150.

4) C. Venkateswaran, Amarnath Padala, H. Sreemoolanadhan, M.R. Ajith, Mariamma Mathew, **S.C. Sharma**, "Development of Machinable Glass-Ceramic without Nucleating Agents", Materials Science Forum, 830-831(2015)pp 436-439

*5)* S. Nagapriya, B. Masin, H. Sreemoolanadhan, M.R. Ajith, Mariamma Mathew and

**S.C. Sharma,** "Permittivities of ultra-low dielectric silica beads and aerogels", Materials Science Forum**,** 830-831(2015)pp 444-447**.**

*6)* H. Sreemoolanadhan, B. Masin, Mariamma Mathew and **S.C. Sharma,** "Development of Patch Antenna Substrate in BaO-4.TiO2 System",Materials Science Forum**,** 830-831(2015)pp 425-428**.**

**Modelling and simulation of material processes**

▪ Modelling of mechanical deformation behaviour of Ni-superalloy based IN718 sheets, prediction of fracture modes and experimental validation.

▪ Prediction and experimental validation of role of temperature and strain rates on mechanical working of rolled sheets of Ni based alloy using constitutive models.

▪ Generation and use of forming limit diagrams for failure analysis of aerospace components based on flat product realized from Ni-superalloy.

▪ Numerical modelling for gating design of moulds for processing investment castings for aerospace applications.

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1) K.S. Prasad, S.K. Panda, S.K. Kar, S.V.S. Narayana Murty and **S.C. Sharma**, "Prediction Capability of Constitutive Models for Inconel 718 Sheets Deformed at Various Elevated Temperatures and strain Rates", Materials Perfomance and Characterization, DOI: 10.1520/MPC20190004.
2) S. Prasad, S.K. Panda, S.K. Das, S.V.S.N. Murty, **S.C. Sharma,** "Prediction of fracture and deep drawing behaviour of solution treated IN718 sheets; mechanical modelling and experimental validation, Material Science and Engineering, A733 (2018) 393-407.
3) K.S. Prasad, S.K. Panda, S.K. Kar, M. Sen, S.V.S. Narayana Murty and **S.C.Sharma**, "Microstructures, Forming Limit and Failure Analysis of Inconel 718 sheets for Fabrication of Aerospace Components, Journal of Materials Engineering and Performance. (ASM International), 26(4) 2017, pp. 1513-1530.
4) K.S. Prasad, S. K. Panda, , S.K. Kar, S.V.S Narayana Murty &**S.C. Sharma**, "Effect of Temperature and Deformation Speed on Formability of IN718 Sheets: Experimentation and Modelling", Materials Science &Engineering, 418(2018) 012055.
5) A. K. Shukla, S.V.S.N. Murty, **S. C. Sharma**. K. Mondal, "Constitutive modeling of hot deformation behaviour of vacuum hot-pressed Cu-8Cr-4Nb alloy", Materials and Design 75 (2015) pp 57-64.
6) K. Sajun P rasad, Sushanta Kumar Panda, Sujoy Kumar Kar, S. V. S. N. Murty, and **S.C. Sharma**, "Effect of Bending Strain in Forming Limit Strain and Stress of IN-718 Sheet Metal", Materials Science Forum**,** 830-831 (2015)pp 238-241.

7) A.K. Bansal, Ankit Sharma, Alok Agarwal, M. Acharya, Govind, **S.C. Sharma**, Koshy M George, "Use of Numerical Modeling for Gating Design of Aerospace Components", Procd. National Seminar on Aerospace Manufacturing: Global trends and national scenario, Pub. SAME, Trivandrum, November 2013, pp180-189.

**Structure and property development in composites processed through advanced techniques**

- Microstructure evaluation in hyper-eutectic Al-Si system processed through spark plasma sintering route for electronic packages application.

- Study of the directionality in sintered properties of infilterated tungsten-copper composite.

- Role of exfoliation in dispersion of short carbon fibres in silicon carbide powders for composite processing

- Morphological study on the mechanism of dispersion of short carbon fibers in SiC powder without the aid of dispersing agent.

- Effectiveness of powder metallurgy technique in designing and processing functionally graded double layered brushing seal for turbo pump application.

- Study on the influence of carbon nano tube dispersion on mechanical properties of Al-Si alloy matrix composites.

- Evaluation of processing of copper-carbon nano tubes composites by vacuum hot pressing technique.

- Property development in copper-carbon nano tube composite processed through high energy milling of constituent powders.

- Development of beryllium-aluminium composites for inertial systems and spacecraft structures through powder metallurgy route.

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1) T.T. Saravanan, M. Kamaraj, **S.C. Sharma**, S. Kumaran, V.S.K. Chakravadhanula, K.V.

Ravikanth, K. Vinoadh Kumar, H. Sreemoolanadhan, "On Characteristic Eutectic free Microstructural Evolution in Hyper electric Al-Si Processed through Spark Plasma Sintering", *J. Materials Letters*, accepted (Ref. MLBLUE-D-20-02420R1)

2) Mahesh Paidpilli, A. Upadhyay, G.P. Khanra and **S.C. Sharma**, "Investigation of Sintered Properties on Infiltrated Tungsten-Copper Composite along the Infiltration Direction", Canadian Metallurgical Quarterly, Vol. 57, No. 1, 2018, pp 120-128.

3) T. T. Saravanan, A. K. Shukla, D. K. Mishra, V. M. J. Sharma, G. P. Khanra, **S. C. Sharma**, "Laser and Plasma based Emerging Material Processing Technologies for Strategic Sectors: A Vista", Procd. 3rdInt. Conf. "Laser and Plasma Applications in Materials Science", Kolkata Jan 15-17, 2015, pp 56-58.

4) D.K. Mishra, T.T. Saravan, G.P. Khanra, **S.C. Sharma**, Koshy M George, "Design and processing of functionally graded double layered bushing seal for turbo pump application", Procd. National Seminar on Aerospace Manufacturing: Global trends and national scenario, Pub. SAME, Trivandrum, November 2013, pp20-26.

5) S. Dineshraj, S. Girikumar, Govind, **S.C. Sharma**, Koshy M. George, "Hot Isocratic Press (HIP) : State-of-the-Art Aerospace Material Manufacturing Process", Procd. National Seminar on Aerospace Manufacturing: Global trends and national scenario, Pub. SAME, Trivandrum, November 2013, pp67-86.

6) P. Chandran, T. Sirimuvva, N. Nayan, A.K. Shukla, S.V.S. Narayana Murty, S.L. Pramod, **S.C. Sharma**, and S.R. Bakshi, "Effect of Carbon Nanotube Dispersion on Mechanical Properties of Aluminium-Silicon Alloy Matrix Composites", J. of Materials Engineering and Performance, ASM International, 21 Dec. 2013, JMEPEG DOI: 10.1007/s11665-013-0835-1

*7)* A.K. Shukla, Niraj Nayan, S.V.S.N. Murty, **S.C. Sharma**, Prathap Chandran, Srinivasa R. Bakshi, Koshy M. George "Processing of Copper-Carbon Nanotube Composites by Vacuum Hot Pressing Technique" Materials Science & Engineering A, **560(2013)365-371.**

8) A.K. Shukla, Niraj Nayan, S.V.S.N. Murty, K. Mondal, **S.C. Sharma**, Koshy M. George, Srinivasa Rao Bakshi, "Processing copper–carbon nanotube composite powders by high energy milling*" Materials Characterization*, Volume 84, October 2013, Pages 58-66.

9) T. T. Saravanan, Amit Sinha, M. Syambabu, D. K. Mishra, G. P. Khanra, P. K. Sinha and **S. C. Sharma**, "Development of beryllium-aluminium composites for inertial systems and spacecraft structures", Procd. "Space Transportation Systems: Challenges and Opportunities" INAE, Nov. 2011,Trivandrum.

## Studies in the areas of high temperature materials, coatings and gradient structures

- Tailoring of density in carbon foams for thermal protection system application.
- Study of thermostructural properties of yttria stabilised zirconina based composite

coatings processed through thermal spraying.

- Evaluation of development of dynamic electric and internal fiction properties in Cu-Cr-Zr-Ti alloy in temperature range of application

- Synthesis of hydrophobic silica aerogels using ambient pressure drying method.

- Study of microstructural and mechanical characteristics of alumina coating on 07X16H6M metallic substrates.

- Role of microstructure in property development in high strength Cu-Ni-Si-Co-Zr alloy

- Effect of process parameters on properties of $MoSi_2$-SiC components for satellite launch vehicle applications

- Property development in hollow silica granules processed through microwave sintering

- Surface modification of multiwall carbon nanotubes by electroless silver coating

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1) S. Nath, I. Manna, A.K.Jha, **S.C. Sharma**, S.K. Prathihar, J.D. Majumdar, "Thermophysical behaviour of thermal sprayed Yttria stabilized zirconia based composite coatings", Ceramics International ,Vol.43, Issue 14, 1st Oct. 2017, 11204-11217.

2) K. Saravanan, V.M.J. Sharma, A.K. Asraff, P.R. Narayanan, **S. C. Sharma**, K. M. George, "Studies on Dynamic Electric and Internal Friction Properties of Cu-Cr-Zr-Ti Alloy Between 25 and $650^0$C", J. Mater. Engg. & Perform. Vol. 24, No.12 (2015) pp 4721-4727.

*3)* J. Srinath ,G. Sudarshan Rao, Deepak Dinesh, P. Ramesh Narayanan, **S.C. Sharma** and Koshy M George, "Microstructural and Mechanical Characterization of Alumina Coating on 07X16H6M Substrate", Materials Science Forum**,** 830-831(2015)pp 667-670**.**

4) Prashant Sharma, I. Manna, A. K. Jha, **S. C. Shrama**, J. D. Majumdar, "Studies on Characteristics of Plasma Sprayed $La_2O_3$–$Y_2O_3$–$ZrO_2$ Thermal Barrier Coating on Ni based Super alloy 718", Procd. 3rdInt. Conf. "Laser and Plasma Applications in Materials Science", Kolkata, Jan 15-17, 2015, pp70 -72.

5) **S. C. Sharma**, "Indigenous Capacity Building for High Temperature Materials for Space", Fellowship Lecture published in INAE Annals-2018.

*6)* S. Nagapriya, M. R. Ajith, H. Sreemoolanadhan, Mariamma Mathew, **S. C. Sharma**, "Hydrophobic silica aerogels by ambient pressure drying", Materials Science Forum**,**

830-831(2015)pp 476-479.

*7)* S. Chenna Krishna, J. Srinath, A.K. Jha, B. Pant, **S.C. Sharma**, K.M. George, "Microstructure and Properties of a High Strength Cu-Ni-Si-Co-Zr Alloy", J. of Materials Engineering and Performance, Vol. 22, No. 2, Feb. 2013.

8) G. P. Khanra, A.K. Jha, S. Girikumar, D. K. Mishra, T. T. Saravanan, and **S. C. Sharma,** "Development of MoSi2-SiC Component for Satellite Launch Vehicle", G. P. Khanra, A.K. Jha, S. Girikumar, D. K. Mishra, T. T. Saravanan, and **S. C. Sharma,** International Scholarly Research Network-Metallurgy, (2012)Article ID 670389.

9) S. Nagapriya, M.R. Ajith, H. Sreemoolanadhan, V.K. Sree Nageswari, C. Simon Wesley, **S.C. Sharma**, "Hollow Silica Granules by Microwave Processing", Adv. Mat. Res.,Vol.585(2012)pp87-91.

*10)* N. Nayan, S. V. S. N. Murty, **S. C. Sharma**, K. Sreekumar and P. P. Sinha "Electoless Coating of Silver on Multiwall Carbon Nanotubes", N. Nayan, S. V. S. N. Murty, S. C. Sharma, K. Sreekumar and P. P. Sinha, Materials Science Forum, 710, (2012)774 – 779**.**

*11)* **S.C. Sharma**, N.K.R. Naidu, M.C. Mittal, T.S. Lakshmanan, P.P. Sinha and V.K. Vaidyan, "Tailoring of Density in Carbon Foams", I.J. Engg. & Mat. Sci.,*Vol.16, Feb.2009.* 12) **S.C. Sharma**, K. Suseelan Nair and M.C. Mittal, "Carbon Foams with Tailored Density - Advanced and Ultralight Materials for Space Applications", Proc. National Seminar on ***"Materials & Manufacturing",*** NAMS Trivandrum, June, 2003, pp 99-107.

**Analytical studies on failure of materials and components**

- Investigative study employing metallographic and structural testing tools for failure of a high strength low alloy (HSLA) 0.15C-1.25Cr-1Mo-0.25V steel pressure vessel

- Metallurgical analysis of failure of pyro bolts fabricated from 17-4PH precipitation hardenable steel for application in separation systems of launch vehicles.

- Study of failed pyro bulk-head initiator using metallographic techniques

- Analytical study of stress corrosion cracking of 18Ni250 grade maraging steel shear bolts used in the inter stage structure of satellite launch vehicles.

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1) S.K. Manwatkar, S.V.S.N. Murty, P.R. Narayanan, **S.C. Sharma**, P.V. Venkitakrishnan, 'Why Do Fasteners Fail? An Insight into the Modes and Mechanisms of Fastener Failures", Pract. Metallogr. 54 (2017) 1, pp. 19-38.

2) S.K. Manwatkar, J. Srinath, S.V.S.N. Murty, P.Ramesh Narayanan, **S.C. Sharma** and P.V. Venkitakrishnan, "Metallurgical Analysis of Cracked AA 7075 Aluminium Alloy Component used in Control System of a Satellite Launch Vehicle", J. Failure Analysis and Prevention, Vol.16(5), Oct.2016.

3) Sushant K. Manwatkar, S.V.S. Narayana Murty. P. R. Narayanan. **S.C. Sharma**& P.V. Venkitakrishnan, "Stress Corrosion Cracking of a Maraging Steel Shear Bolt Used in the Interstage Structure of a Satellite Launch Vehicle", Metall., Microstr. & Analysis, Vol. 5, No.5, Oct. 2016, pp 411-420.
4) S.V.S.N. Murty, S. Manwatkar, P. R. Narayanan, **S. C. Sharma,** K.M. George, "Metallurgical Analysis of a Failed Through Bulkhead Initiator Used in Pyrosystems of Launch Vehicles", Metall., Microstr. & Analysis, Vol. 4, No. 1, Feb. 2015.
5) J. Srinath, S. K. Manwatkar, S.V.S.N. Murty, P. Ramesh Narayanan, **S.C. Sharma,** Koshy M. George, "Metallurgical Analysis of a Failed 17-4 PH Stainless Steel Pyro Bolt Used in Launch Vehicle Separation Systems", Materials Performance and Characterization 4(1)(2015) pp 29-44.
6) A.K Jha, S.K. Manwatkar, P.R. Narayanan, B. Pant, **S.C. Sharma** andKoshy M. George, "Failure analysis of a high strength low alloy 0.15C-1.25Cr-1Mo-0.25V steel pressure vessel,Case Studies in Engineering Failure Analysis, 1 (2013) 265-272.

**Behavioural and compatibility studies on space materials**

- Study of nano-mechanical and corrosion behaviour of magnetron sputtered Al-Mo gradient coated steel.

- Evaluation of stress corrosion cracking behaviour of plate-to-ring weld joints of aluminium alloy AA 2219 in media comprising 3.5 wt% NaCl solution.

- Behavioural studies into nano mechanical characteristics and corrosion of plasma electrolytic oxidation coated aluminium alloy AA7020 in T6 tempered condition.

- Influence of micro arc oxidation treatment on the corrosion and stress corrosion cracking behaviour of AA7020-T6 aluminium alloy.

- Study of effect of thermo mechanical treatment on the environmentally induced cracking behaviour of AA7075 alloy

- Analysis of corrosion and multi-scale mechanical behaviour of plasma electrolytic oxidation and hard anodized coatings on AA2219 aluminium alloy.

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1) A. Venugopal, P. Ramesh Narayanan and **S.C. Sharma**, "Evolution of Microstructure and Stress Corrosion Cracking Behaviour of AA 2719 Plate to Ring Weld Joints in 3.5 wt. pct. NaCl Solution", Met. & Material. Trans. A, Vol. 47, No.4, April 2016, pp 1607-1620.

2) A. Venugopal, J Srinath, L. Ramakrishna, P. Ramesh Narayanan, **S.C. Sharma**, P.V. Venkitakrishnan, "Corrosion and nanomechanical behaviour of plasma electrolytic oxidation coated AA 7020-T6 aluminium alloy", Materials Science & Engineering A, 660 (2016), pp 39-46.
3) A. Venugopal, P. Ramesh Narayanan and **S.C. Sharma**, "Effect of Micro Arc Oxidation Treatment on the Corrosion and Stress Corrosion Cracking (SCC) Behaviours of AA7020-T6 Aluminum Alloy in 3.5% NaCl Solution", Materials Science Forum, 830-831(2015)pp 639-642**.**
4) A. Venugopal, J. Srinath, P. Ramesh Narayanan, **S.C. Sharma** and Koshy M. George, "Corrosion and Multi-scale Mechanical Behaviour of Plasma Electrolytic Oxidation (PEO) and Hard Anodized (HA) Coatings on AA2219 Aluminum Alloy",Materials Science Forum, 830-831(2015)pp 627-630**.**
5) R.Ghosh, A. Venugopal, P. Sankaravelayudham, Raju Panda, **S.C. Sharma**, Koshy M. George, V.S.Raja, "Effect of Thermomechanical Treatment on the Environmentally Induced Cracking Behaviour of AA7075 Alloy", J. Mat. Engg. & Performance Vol.23 No.12(2014).

## Design and development of cast-products using investment and rheo casting routes

- Study for improvement of moulding process of investment castings by evaluating the shell cracking behaviour using quick cast rapid prototype polymer patterns.

- Evaluation of effectiveness of hot isostatic pressing technology in healing defects in precision investment cast products.

- Role of process parameters under rheo casting semi-solid metal processing technology for developing thin walled A-356 components

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*1)* S. Dineshraj, Mayukh Acharya, Alok Agarwal, Girikumar S, Govind, **S.C. Sharma** and Koshy M. George, "Development of Hot Isostatic Pressing Technology for Investment Cast Products", Materials Science Forum, 830-831(2015)pp 19-22**.**
2) V.M. Nimbalkar, B. Bhanushali, M. Mohape, S. G. Pandav, V. P. Deshmukh, S. Dineshraj, Mayukh Acharya, Alok Agarwal, Govind, and **S.C. Sharma**, "Development of Thin walled A-356 Components by New Rheocasting Semi-Solid Metal Processing Technology (NRC)", Materials Science Forum, 830-831(2015) pp 27-29.
3) A. Sharma, M. Acharya, A. Agarwal, Govind, **S. C. Sharma**, K. Sreekumar and P. P. Sinha, "Study of Shell Cracking Behavior and its Remedies in Investment Casting Process Using Quick Cast Rapid Prototype Polymer Patterns", Materials Science Forum, 710, (2012)214-219.

## Characterisation of advanced materials

- Evaluation of variation of dynamic elastic and internal friction properties of Nickel

based super alloys with temperature

- Study of role of sub-zero temperatures on mechanical properties of aluminium-copper-lithium alloy AA 2195.

- Measurement and analysis of ambient and cryogenic tensile properties of pre-aging cold worked aluminium-copper-lithium sheets T87 processed through a combination of cold rolling and stretching parameters.

- Fatigue behaviour of AISI 304L stainless steel plumbing tubes under axial and bending modes for application in launch vehicle control systems.

- Role of nano-indentation in evaluating properties of Cu-8at%Cr-4at%Nb alloy processed through hot pressing method.

- Nano-indentation study for characterization of electrical discharge machined M300 maraging steel flexures

- Evaluation of integrity of structural and thermostructural materials for space applications.

- Behavioural study on thermal conductivity of cryogenic engine thrust chamber alloy Cu-Cr-Zr-Ti in application temperature range.

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1) P. Manikandan, G. Sudarsana Rao, J. Srinath,, V.M.J. Sharma, P. Ramesh Narayanan, **S.C. Sharma**, and Koshy M. George, "Axial and Bending Fatigue Testing of AISI 304 L Plumbing Tubes used for Launch Vehicles Control System", Materials Science Forum, 830-831(2015) pp 187-190.

*2)* K. Saravanan, V.M.J. Sharma, P. Ramesh Narayanan, S.C. **Sharma**, and Koshy M. George, "On the measurement of dynamic elastic and internal friction properties of nickel based super alloys upto 650°C temperature", Materials Science Forum, 830-831(2015) pp 203-206**.**

3) J. Srinath, G. Sudarshan Rao, G. Nagamalleswara Rao, Joji J. Chaman, P. Ramesh Narayanan, **S. C. Sharma**, and Koshy M. George, "Characterization of the Electrical Discharge Machined M300 Maraging Steel Flexures using Nanoindentation",Materials Science Forum, 830-831 (2015)pp 395-39***8.***

4) V.M.J Sharma, G.Sudharshan Rao, **S.C. Sharma**, Koshy M. George, "Low Cycle Fatigue Behaviour of AA 2219-T 87 at Room Temperature", Materials Performance and Characterization, Vol.3 No1(2014) 103-125.

5) A.K.Shukla, V.M.J Sharma, S.V.S.N.Murty, P. Ramesh Narayanan, **S.C. Sharma,** "Integrity of Structural and Thermostructural Materials for Indian Space Programme", Procedia Engineering, 86(2014) 8-17.

6) N. Nayan , S. V. S. N Murty, A. K. Jha, Bhanu Pant, **S. C. Sharma,** Koshy M George Mechanical properties of aluminium- copper-lithium alloy AA 2195 at cryogenic temperatures", Materials & Design, 58(2014) 445 - 450.

*7)* N. Nayan, S.V.S. Narayana Murty, A.K. Mukhopadhyay, K.S. Prasad, A.K. Jha, B. Pant, **S.C. Sharma**, K.M. George "Ambient and cryogenic tensile properties of AA2195T87 sheets with pre-aging cold work by a combination of cold rolling and stretching"Materials Science and Engineering: A**,** Volume 585, 15 November 2013, Pages 475-479

8) J. Srinath,A.K. Shukla,VMJ Sharma, Ramesh Narayanan, **S.C. Sharma**, "*Nanoindentation Studies on Hot Pressed Cu-8 at%Cr -4at% Nb Alloy*", Proc. Nano India, 2013, Trivandrum, February 2013

9) S. Chenna Krishna, N. Supriya, A.K. Jha, B. Pant, **S.C. Sharma** and Koshy M. George "Thermal Conductivity of Cu-Cr-Zr-Ti Alloy in the Temperature Range of 300-873 K", International Scholarly Research Network-Metallurgy**,** (2012)Article ID 580659.

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**ANNEXURE-III**

## Supervision of Ph.D. Projects and Examiner of Ph.D. Theses

**A. Supervised following Ph.D. Projects as Co-guide:**

- "Studies on Carbon/Carbon Composite Bipolar Plate for FEM Fuel Cell in Aerospace Applications" by Shri T.S.K. Raunija, MMG/VSSC; IIT, Delhi (Degree awarded in June 2017)

- "Processing of Low Thermal Expansions Glass-Ceramic from Lithium Alumino Silicate (LAS) Glass" by C. Venkateswaran, MMG/VSSC at IIT, Mandi (Degree awarded, July, 2021)

- "Microstructual Evolution in Spark Plasma Sintered P/M Structures" by T. T. Saravanan, MMG/VSSC at IIT, Chennai (Thesis under submission)

**B. Examiner of Ph.D. Theses from following Institutes:**

- Indian Institute of Technology(BHU), Varanasi
- Anna University, Chennai,
- Indian Institute of Technology, Bombay

## ANNEXURE-IV

# Patents

- Thakur S.K. Raunija**,** Mariamma Mathew, **S.C. Sharma** and P.V. Venkitakrishnan, "Process for preparing carbon/silicon carbide", Patent granted, No. 337549

- S. Nagapriya, M. R. Ajith, H. Sreemoolanadhan, Mariamma Mathew, **S. C. Sharma,** "A process for preparation of spherical Silica shells with fibrous internal network". Patent granted, No. 352169.

- T. Venkateswaran, D. Sivakumar, T. Tharian, **S.C. Sharma**, M.C. Mittal, "Method of Producing Sheets and Foils from Brittle Metallic Alloys", Patent granted, No. 315483.

- K.N. Sudhakaran, Govind, Neeraj Nayan, **S.C. Sharma**, M.C. Mittal, "A Metal Injector and a Process of Producing Alloys Containing Highly Reactive Metals", Patent granted. No. 271289.

- H. Sreemoolanadhan, B. Main, C. Simon Wesley, **S. C. Sharma**, Koshy M George, "Method of producing high permittivity low-loss and thermally stable dielectric ceramics"- Filed, No.1856/CHE.

- Thakur S.K. Raunija,S. Babu and **S.C.Sharma**, "Carbon/silicon carbide composites and a method of their manufacture", Patent granted. No. 369606**.**

- T. S. K. Raunija, Mariamma Mathew, **S. C. Sharma**, Anil Verma, "An improved permeability tester capable of measuring permeability of bipolar and unipolar plates", Filed, No. 201641037031.

- S. Reshmi, S. Gayathri, G. Santhosh, M. Sreejith, S. Suraj, Elizabeth John, and **S. C. Sharma**, "Oxygen emanating composite solid propellants", Filed

# ANNEXURE-V

## Professional Recognition/Awards/Honours

- ☐ **"Fellowship"** of the **Indian Institute of Ceramics** (IIC), 2020
- ☐ **"VASVIK Award"** for Industrial Research in Materials, 2017
- ☐ **"Fellowship"** of the **Indian National Academy of Engineering** (INAE), 2017
- ☐ **"Distinguished Alumnus Award"** of the **Indian Institute of Technology**, (IIT), Roorkee, 2014
- ☐ **"ISRO Merit Award-2015"**
- ☐ **"Fellowship"** of the **Indian Institute of Metals,** 2015
- ☐ **"Metallurgist of the Year"** Award of the Ministry of Steel, Govt. of India,2003
- ☐ **Visiting Scientist,** German Aerospace Establishment(DLR), Jan.-Oct. 1992.
- ☐ "**Certificate of Appreciation"** from **International Astronautical Federation (IAF)** in Oct. 2002 for outstanding contributions to the activities of IAF's Technical Committee on "Microgravity Sciences and Processes" as its Member.
- ☐ **Invited for technical lectures** on the results of his micro-g experiments on Ni3Al and Al-Fe alloy system, at **Materials Engineering Department, Royal Institute of Technology, Stockholm, Sweden, Section d'Etudes de la Solidification et de la Crystallogenes, Grenoble, France** and **Institute for Space Simulation, DLR, Cologne, Germany**.(July/August, 1992)
- ☐ **Invited and chaired a Technical Session**, "Microgravity Environment - Modelling, Measurement, Evaluation: User Requirements and their Realization", during **40th Congress of International Astronautical Federation held at Malaga, Spain** in October 1989.
- ☐ **Invited and chaired a Technical Session**, "Phase Stability in Quasicrystals" during the **8th International Conference on Quasicrystals (ICQ-8) held in IISc, Bangalore** in Sept., 2002.
- ☐ **Tendulkar Award for the Best Paper** "Development of Invar-Silver Composite for MIC Carrier Plate of Satellites", D.K. Mishra, T.T. Saravanan, G.P. Khanra, S.C. Sharma & K.M. George", Int. Conf. 'Powder Metallurgy & Particulate Materials' by Powder Metallurgy Association of India (PMAI) at IIT Mumbai. Jan.19-21, 2015.

# ANNEXURE-VI

## Invited Papers/Keynote Lectures

1) **S.C. Sharma**, Prof. N. K. Batra Memorial Lecture, "Indian Space Programmes and the Role of Materials", organised by IIM, Kanpur Chapter and Materials Science & Engineering Dept. IIT, Kanpur, Oct 4, 2020.
2) **S.C. Sharma**, Invited Talk "Materials for Indian Space Programme: Achievements to bank upon and challenges to look forward" at IIM, Jamshedpur Chapter, 4th December, 2020.
3) **S.C. Sharma**, Inaugural Talk "Development of Materials for Space Applications", at National Metallurgist Day, Amal Jyothi College of Engineering, Kanjirapally, Nov 14, 2020.
4) **S.C. Sharma,** "Indigenous Capacity Building for High Temperature Materials for India Space Programme", presented in the Annual Convention of the Indian National Academy of Engineering (INAE) at Chennai, Dec. 15, 2017.
5) **S.C. Sharma,** "Growth of Quasicrystals aboard Indian Microgravity Platform (SRE-1)", presented in the 24th session of the Asia-Pacific Regional Space Agency Forum (APRSAF-24), Bangalore, Nov. 15, 2017.
6) **S.C. Sharma**, "Materials for Indian Space Programme: Achievements to bank upon and challenges to look forward", presented in Int. Conf. "Light Weighting for Aerospace, Defence and Transportation" by IIM, at BITS, Goa, Nov. 12, 2017.
7) **S.C. Sharma**, "Development of Thermo structural Materials for Indian Space Programme", presented in Int. Conf. "Materials Engineering" by IIT, Kanpur and IIM, Kanpur Ch. at Kanpur, June 3, 2017.
8) **S.C. Sharma**, "Indigenization of Materials for Indian Space Programme: Achievements and Challenges Ahead, at Dept. of Chemical Engineering, IIT, Delhi, May 10, 2017.
9) **S.C. Sharma**, "Quest for Sensors: A Sojourn through Nature and Adaptation by Mankind", Keynote lecture in Technical Seminar (Hindi) on "Sensors and Actuators" at IISU, Trivandrum, March 16, 2017.
10) **S.C. Sharma,** "Towards Self-reliance in High Temperature Materials for Indian Space Programme", presented in 2ndInt. Structural Integrity Conference and Exhibition (SICE-2018) by DMRL and Indian Structural Integrity Society, at Hyderabad, Jul. 26, 2018.
11) **S.C. Sharma,** "Development and Delivery of Thermal Protection Systems for Indian Space Programme : Challenges and Opportunities",presented in National Seminar on Development, Processing and Applications of High Temperature Material – Current Trends and Challenges organized by IIM, Hyderabad Ch. and MIDHANI, at Hyderabad, Feb. 02, 2018.
12) **S.C. Sharma,** "Batteries for Space Applications", delivered at National workshop on "Battery Technology and Electrical Mobility" organized by HP Green R&D Centre, Hindustan Petroleum Corp. Ltd. At Bangalore on March 08, 2018.
13) A.K. Gupta, A. Kumar, Sarvesha R, J. Bhagyaraj, G.Telasarg, G. Padmanabhan, **S.C. Sharma**, M.R. Ajith, J. Jain, I. Manna, S.S. Singh " Microstructural and mechanical characterization of Ni-Cr alloys prepared by Direct Metal Deposition (DMD)

process, Presented in the 3rdInt. Conf. on Advanced Materials and Manufacturing Processes for Strategic Sectors (ICAMPS2018), Trivandrum Oct 23-25, 2018.

14) **S.C. Sharma**, "Make in India : Towards Self-reliance in Materials for Indian Space Programme", Keynote Lecture in International Conference on Recent Trends in Materials Science and Technology (ICMST-2018), Trivandrum, Oct 10-13, 2018.
15) **S.C. Sharma**, "Materials for Indian Space Programme: Achievements and Road Ahead", Invited Lecture in IIM Lecture Series for 2018-19 at IIT, Kanpur on Oct 22, 2018.
16) Niraj Nayan, S.V.S. Narayana Murty and **S. C. Sharma**, "Property and structure development in Al-Cu-Li alloy AA2195 with Sc/Nb processed through vacuum induction melting", Invited paper in 7thInt. Conf. on 'Solidification Science and Processing' (ICSSP-2018), Trivandrum, Nov. 19-22, 2018.
17) "Development of High Temperature Materials for Indian Space Programme", **S.C. Sharma**, Invited paper presented at Indo-South Korea (INAE-NAEK) Workshop at Hyderabad during Jul. 14-16, 2019.
18) S.C. Sharma, "Make in India: Towards Self-reliance in Hafnium Extraction Technology". Keynote lecture at Nat. Symp. "Minerals & Energy Materials Technology (MEMT-2019", NIIST, Trivandrum, April 08, 2019.
19) **S.C. Sharma**, "The Indigenous Hafnium Metal : A Journey from Crust to Space"- delivered at the International Conference on " Metals & Materials Research" (ICMR-2016), IISc, Bangalore, June 20-22, 2016.
20) **S.C. Sharma,** "Development of Carbon/Carbon Composite Bipolar Plates for PEM Fuel Cell Applications in Space"- delivered at National Conference "Material Science and Technology" (NCMST -2016), IIST, Trivandrum, July 12 – 14, 2016.
21) **S.C. Sharma,** "Self-reliance in Space Materials : Achievements & Challenges" – delivered at National Seminar on "Make in India – Opportunities and Challenges", Amal Jyothi College of Engineering (AJCE), Kottayam, April 12 – 13, 2016.
22) **S.C. Sharma**, "Role of High Temperature Materials in Emerging Indian Space Programme", -- delivered at National Conf. "Advances in Refractory and Reactive Metals & Alloys" (ARRMA-2016), BARC, Mumbai, Jan. 27-29, 2016.
23) **S.C. Sharma,** "Development of Al-Li Alloy AA2195 for Indian Space Programme" – delivered at the Colloq. in MIDHANI, Hyderabad, Feb. 16, 2016.
24) **S.C. Sharma**, Graduation Day Address, SSM College of Engineering & Technology, Dindigul, April 16, 2016.
25) **S. C. Sharma**, "Emerging Space Programmes and Challenges for Material Scientists", Invited paper in the Theme Session 'Áerospace Materials' at 69th Annual Tech. Meet. of the Indian Institute of Metals, Coimbatore, Nov. 13-15, 2015.
26) **S. C. Sharma**, "Towards Self-reliance in Space Materials", Invited paper at Nat. Conf. 'Metallurgical Industries – Sustainability and Value Addition', Org. by ASM International, Bangalore Ch. and IIM, Bangalore Ch., Bangalore, 3-5 Dec., 2015.
27) **S. C. Sharma**, "Development Efforts for Indigenization of Materials for Indian Space Programme", Invited lecture at Satellite Application Centre, Org. by Space Society of Mech. Engineers (SSME), Ahmedabad, Nov. 23, 2015.
28) **S. C. Sharma**, "Materials for Indian Space Programmes: A. Vista", Invited Paper at Int. Conf. 'Advances in Materials Manufacturing and Applications', Org. by NIT, Trichy, April, 9-11, 2015.

29) **S. C. Sharma**, "Materials Development for Indian Space Programme", Invited Lecture at Karunya University, Coimbatore, Feb. 04, 2015.

30) **S. C. Sharma**, "Evolution of Testing and Characterization Practice of Materials for Indian Space Programme", Keynote Lecture at Technical Hindi Seminar 'Systems Testing for Launch Vehicle and Spacecrafts', at IISU, Trivandrum, Jan.13, 2015.

31) **S.C. Sharma,** "Towards self-reliance in materials for Indian space programme", , Invited Paper in National Seminar on "Engineering Trends in Aero Engine Architecture and Self-reliance", HAL, Koraput, Dec.6-7, 2014.

32) **S.C. Sharma,** "Materials for Indian space program : Achievements we bank upon and challenges we look forward ….", **,** Invited Paper in Discussion Meeting on "Structural Engineering Materials for the Future: The Way Forward", organized by Indian National Academy of Sciences and IISc at Coorg, Dec. 3-6, 2014.

33) **S.C. Sharma**, "Materials for Emerging Indian Space Programmes", at METEX-2013, International Exhibition & Seminar on Materials by IIM, Bangalore Chapter, Sept. 2013.

34) **S.C. Sharma**, "Indian Space Mission: Heat Resistant Tiles for Reentry Vehicle", in the Session "Materials Development: Indian Story of Struggle and Success", during Annual Technical Meeting of the Indian Institute of Metals at BHU, Varanasi, Nov.14, 2013.

35) **S.C. Sharma**, "New Paradigms in Materials for Indian Space Programme" at IISc, Bangalore, Prof. Brham Prakash Centenary Retrospective, by IIM, Bangalore Chapter, Aug. 2013

36) **S.C. Sharma**, "Indian Space Porgramme vis-à-vis Challenges for Material Scientists" at Christ University, Bangalore, Aug. 2013

37) **S.C. Sharma**, "Materials for Emerging Indian Space Programmes" at International Exhibition & Seminar on Materials by IIM, Bangalore Chapter, Sept. 2013. 38) S**.C. Sharma**, "Materials for Space" Invited Five-lecture Series on in the 5th PG Course conducted by the UN Affiliated Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) at Ahmedabad, November 6-8, 2006. Also prepared lecture notes for distribution among the course participants, who hailed from five countries.

39) **S.C. Sharma**, Govind, N.K. Ramakrishna Naidu, K. Suseelan Nair, M.C. Mittal and K.N. Ninan Invited Technical Lecture "Nano materials and their potential space applications", Invited Paper in National Seminar on "Recent Advances in Nanotechnology", NI College of Engineering, Thucklay, March, 2006.

40) **S.C. Sharma**, Govind, N.K. Ramakrishna Naidu, K. Suseelan Nair, M.C. Mittal and K.N. Ninan, "Materials with nano features and their potential applications", Invited Paper at the National seminar on "Nano technology", All Saints College, Trivandrum August, 2006.

41) **S.C. Sharma**, "Processing in Space : Excitements and Opportunities", Invited Paper in Annual Technical Meeting of Materials Research Society of India, Trivandrum Chapter, May 15, 2007

42) **S.C. Sharma**, "Isothermal Heating Furnace for Materials Science Experiments in Microgravity" Invited Paper in the 14th Meeting of Asia Pacific Regional Space Agency Forum at Bangalore, Nov. 22-24, 2007.

43) **S.C. Sharma**, S.V.S. Narayana Murthy, M.C. Mittal and K.N. Ninan "Nano Materials Technology for Space Applications : Current Trends and Future Directions". Invited Paper in International conference on "Emerging, Exciting worlds of

Nanotechnology" organized by Nano technology working committee of NICE, Kumaracoil during 25th to 26th Oct 2007.

44) **S.C. Sharma**, S.V.N. Murty, K. Suseelan Nair, M.C. Mittal and K.N. Ninan "Special Potential of Nano Materials Technology for Space Applications". Invited Paper at workshop on" Nanoscience and nanotechnology "organized by Amrita Vishwa Vidhyapeedam, Amritapuri, Kollam during 14-18th May 2007 at Kollam.

45) **S.C. Sharma**, Govind, N.K.R. Naidu, K Suseelan Nair, M.C. Mittal and K.N. Ninan "Nano Materials Technology for Space Applications". Invited Paper in National Seminar on "Nano technology- The technology for Future", organized by Govt. Engg. College, Trivandrum on 28th March 2007 in Trivandrum.

46) S. Girikumar, GP Khanra, **S.C. Sharma**, K Sreekumar and PP Sinha, "Development of Powder Metallurgy Products for Indian Space Programmes", Invited paper in 4th Asian Particle Technology Symposium on Innovations in Particle Technology", New Delhi, Sept., 2009.

47) **S.C. Sharma**, "Metallic Materials for Indian Space Programmes : Current Trends and Future Perspectives", Invited Paper in " VOXMATERIA", Indian Inst. of Space Science and Technology, Trivandrum, Nov. 2009.

# ANNEXURE-VII

## Papers co-authored/authored and presented in National/International Conferences/Seminars/Symposia

1) "Effect of Phosphorous Pentoxide in processing lithium alumino silicate glass ceramic through bulk and sintering route", C. Venkateswaran, H Sreemoolanadhan, **S.C. Sharma,** B. Pant, V.S. Chauhan & R. Vaish, International Conf. "Advanced Thermostructural Materials & Thermal Protection Systems (ADTHERM'20", Trivandrum, Jan. 19-20, 2020 **(Best Paper Award)**
2) R. Ghosh, P. Manikandan, G.S. Rao, A. Venugopal, P.R. Narayanan, **S.C. Sharma**. P.V. Venkitakrishnan, "Ëffect of Pre-corrosion on the Fatigue Behaviour of AA 2219-T-851 Al alloy", 17th Asia Pacific Corrosion Control Conf. (APCCC-17), IIT. Mumbai, Feb. 04-05, 2016.
3) G. Sudarshan Rao, Manikandan P., Naresh Kumar K., Antony Prabu, S.K. Singh, P. Ramesh Narayanan, Abhay K. Jha, **S.C. Sharma** and Bhanu Pant, "Fracture properties of Forged TiA12.5Sn-Eli alloy at room and Cryogenic Temperature", Presented at Int. Conf. on 'Fatigue, Durability and Fracture Mechanics', 28-30th May 2015, Bangalore, India.
4) G. Sudarshan Rao, V.M.J. Sharma, P. Ramesh Narayanan, **S.C. Sharma&** Koshy M. George, "Evaluation of High Temperature Fracture Properties in Inert Atmosphere using Laser Extensometer", Presented at Int. Conf. on 'Fatigue, Durability and Fracture Mechanics', 28-30th May 2015, Bangalore, India.
5) D.K. Mishra, T.T. Saravanan, G.P. Khanra, **S.C. Sharma&** Koshy M. George, "Development of Invar-Silver Composite for MIC Carrier Plate of Satellites," Int. Conf. on 'Powder Metallurgy and Particulate Materials'(PM-15), Jan. 19-21, 2015, Mumbai.
6) Omendra Mishra, Thakur Sudesh Kumar Raunija, Mariamma Mathew, **Sharad Chandra Sharma** and Koshy M George, "Ablative carbon fabric through catalytic process," Presented in Nat. Sym. 'Human Space Programme : Current and Future Perspectives' at VSSC, Thiruvananthapuram, 24th July 2015.
7) S. Dineshraj, Girikumar S., Govind, **S. C. Sharma**, P. V. Venkitakrishnan, **"**Study on the Healing of Critical Cast Defects by Hot Isostatic Pressing Technology,"Presented in poster category in the 69th Annual Technical Meeting of the Indian Institute of Metals(IIM) on 'New Horizons in Materials Processing and Applications', Coimbatore, 13-16 Nov., 2015.
8) A.K. Bansal, Ankit Sharma, M. Acharya, Alok Agarwal, Govind, **S.C. Sharma,** "Design of gating and risering system for pump casing investment castings", presented at Annual Tech. Meet of Indian Institute of Metals, Pune, Nov. 15-17, 2014.
9) Ankit Sharma, A.K. Bansal, M. Acharya, Alok Agarwal, Govind, **S.C. Sharma,** "Optimization of ageing cycle of stainless Maraging steel using dilatometric and DSC analysis to improve its strength", presented at Annual Tech. Meet of Indian Institute of Metals, Pune, Nov. 15-17, 2014.
10) D. K. Mishra, T. T. Saravanan, G. P. Khanra, **S. C. Sharma**, Koshy M. George, "Development of Invar Silver composite for MIC carrier plate of satellites",

Accepted for presentation in International Conf. on "Powder Metallurgy & Particulate Materials"-PM15.

11) S.V. S. N. Murty, J. Srinath, S. K. Manwatkar, P. R. Narayanan, **S. C. Sharma**, K. M. George, "Role of mechanical property anisotropy in the selection of materials for high staminate applications", presented at 6$^{8th}$ Annual Tech. Meet of the Indian Institute of Metals, NMD-ATM 2014 at COEP, Pune.
12) G. S. Rao, K. Saravanan, V. M. J Sharma, P. R. Narayanan, **S. C. Sharma**, B. Pant, Koshy M George," High staminate deformation behavior of AA 2219-T87 alloy used in Space application". Presented in poster sections at National Cart on "Space Debris Management & Mitigation Techniques" organized by ASI and ISRO at ISRO HQ, Bangalore, 20 -21 May, 2014.
13) Niraj Nayan, S. V. S. N. Murty, **S. C. Sharma**, K. Sreekumar and P. P. Sinha, "Al-Cu-Li Alloy for cryogenic propellant Tanks: Technological challenges in Scale up Melting and ISRO's Achievements", presented at NMD ATM 2011, 13-16 November 2011, Hyderabad.
14) Alok Agarwal, Niraj Nayan, Govind, **S. C. Sharma**, K. Sreekumar and P. P. Sinha, "Development of V65 alloy rivet wires for space application", presented at National seminar on Light Metals, Alloys and Composites for Aerospace, Automative, Defence and Energy Sectors (LACOM 2011), 28-29April,2011,Trivandrum.
15) Ankit Sharma, Mayukh Acharaya, Alok Agarwal, Govind &**S. C. Sharma**,"Development of Investment Castings using Semi Hollow Rapid Prototype. Polymer Pattern", presented in National Seminar on "Light Metals, Alloys and Composites for Aerospace, Automotive, Defence and Energy Sectors" (LACOM 2011), April 2011, Trivandrum.
16) DK Mishra, TT Saravanan, S Girikumar, GP Khanra, **SC Sharma**, K.Sreekumar and PP Sinha, Technical Paper "Studies on the Processing of Ni based Porous Wick for CPL for Thermal Management of Satellites", 2009, Technical paper in 4$^{th}$ Asian Particle Technology Symposium, New Delhi, Sept. 2009.
17) R Jaiswal, A Upadhyay and **SC Sharma**, "Effect of Compaction Pressure and Sn Content on the Sintering Behavior of Bronze", Technical paper in 4$^{th}$ Asian Particle Technology Symposium, New Delhi, Sept.2009.
18) GP Khanra, DK Mishra, TT Saravanan, S Girikumar, **SC Sharma**, K Sreekumar and PP Sinha, "Processing and Characterization of Ni Base Porous Wicks for Capillary Pump Loop System of Satellites", Technical paper in National Seminar on "Powder Metallurgy and Porous Materials", Kolkata, Aug., 2009.
19) T.T. Saravanan, DK Mishra, , S Girikumar, GP Khanra, **SC Sharma**, K Sreekumar and PP Sinha, "Development of $CuNiCaF_2$ Metal Matrix Composite Through Powder Metallurgy Route for High Speed Friction Applications", Technical Paper in International Conf. on Advanced Functional Materials, Trivandrum, Dec. 2009.
20) R.Jaiswal, A. Upadhyaya, **S.C. Sharma, "**Sintering Studies in Micro-g and Terrestrial Conditions**",** Technicalpaper in Int. conf. on "High performance Materials by Powder Metallurgy", 39$^{th}$ ATM of PMAI, Goa, Feb. 2009.
21) Alok Agarwal, Govind and **S.C. Sharma**, "Hydrogen Storage in Magnesium Based Hydrides", presented in National Seminar on "Special Purpose, Strategic and Futuristic Materials for High Technology Sectors", IIM, Trivandrum, Oct. 2008.
22) D.K. Mishra, G.P. Khanra, S. Girikumar and **S.C. Sharma**, "Sintering behaviour and microstructural characteristics of porous nickel wicks for capillary pumploops" presented in National Seminar on "Special Purpose, Strategic and Futuristic

Materials for High Technology Sectors", IIM, Trivandrum, Oct. 2008..

23) K. Thomas Tharian, N.K. Ramakrishna Naidu, **S.C. Sharma** and M.C. Mittal, "Materials for Oxygen Rich High Temperature Environments of Semi-cryogenic Engine", Paper presented in the National Conference on 'Advanced Materials For Hostile Environments: Present Scenario and Future Perspectives' during 1-2nd March 2007 in Trivandrum.

24) Pravin Muneshwar, NKR Naidu, S.K.Singh, Thomas Tharian, Bhanu Pant, **S.C. Sharma**& M.C.Mittal. "Metallic Thermal Protection Systems for Re-entry Launch Vehicles-A overview" Paper presented in National conference on Advance Materials for Hostile environments resent scenario and future perspective' 1-2nd March 2007 organized by IIM, Trivandrum Chapter.

25) S. Jyothi, K.T. Tharian, **S.C. Sharma**, "Modern Thrust Chamber Materials", Paper presented in the Annual Technical Meeting of Powder Metallurgy Association of India, Hyderabad, January, 2006.

26) T. Venkateswaran, D. Sivakumar, K.T. Tharian and **S.C. Sharma** "Spark plasma sintering of $ZrB_2$ based composites", Paper presented in the National Seminar on Advances in Nano, Metallic and Ceramic Composites, IIM Trivandrum Ch., Feb.2006.

27) T. Venkateswaran, P. Muneshwar, S.K. Singh, K.N. Sudhakaran, B. Pant, **S.C. Sharma**, "Development of Isothermal Pack Rolling Technology of Ti6Al4V Alloy for Space Applications", Paper presented in the 44th NMD-ATM of IIM, Jamshedpur, November 2006.

28) **S.C. Sharma**, "Ceramic Materials for Aerospace Applications"- Invited Paper at HRDD Refresher Course on "Materials Technology for Aerospace Applications, VSSC, October, 2006.

29) **S. C.Sharma**, "Processing under Micro-g : An Overview and the Indian Initiative", Annual Technical Meeting of Kerala Chapter of the Indian Institute of Chemical Engineers, April,2004.

30) **S. C.Sharma**, "Development of Special Materials for Indian Space Programmes" -, 57th Annual Technical Meeting of the Indian Institute of Metals, Kolkata, November, 2003.

31) S. Gupta, **S. C.Sharma**, K.S.Nair and M.C.Mittal, "Development and Use of Structural Materials for Indian Space Programme", Hindi Seminar on Four Decades of Rocketry in India : Achievements and Challenges", Trivandrum, Oct., 2003.

32) **S. C. Sharma**, K. Suseelan Nair and M.C. Mittal, "Light Structural Materials for Indian Space Programmes : Current Scenario and Future Directions", National Seminar on Light Materials, IISc, Bngalore March16-17, 2003.

33) **S. C. Sharma**, K. Suseelan Nair and M.C. Mittal, "Development of Carbon Foams – A Novel Ultra Light Structural Material" National Conf. on Light Materials and Composites for Strategic and Social Needs" RRL-T(CSIR), Oct. 22-23, 2002.

34) **S. C. Sharma**, K. Suseelan Nair, M.C. Mittal, P. Ramachandra Rao and K. Chattopadhyay, "Growth of Quasicrystals in Space : Possible Fallouts and the Indian Experiment" – 8thInternational Conf. on Quasicrystals (ICQ–8), IISc, Bangalore, Sept. 8-13, 2002.

35) S. Gupta, **S. C. Sharma**, K. Suseelan Nair and M.C. Mittal, "Smart Materials Technolgy for Space Applications" National Seminar on Materials used in Smart Defence Systems, DMRL, Hyderabad, Sept. 6, 2002.

36) **S. C. Sharma**, K. Suseelan Nair and P.P.Sinha, "Consolidation Characteristics of

Nanocrystalline Fe-Ni and Fe-Ni-Cu Soft Magnetic Ribbons" - presented in the Conf. on "Perspectives in Physical Metallurgy and Materials Science", held in IISc, Bangalore, Jul.12-14, 2001.

37) **S. C. Sharma** and P.P. Sinha, "Influence of Free Surfaces on the Synthesis of Ti-Al and Ti-Al base Composite: Processing Pathways vis-a-vis Microstructure Development under Microgravity Environment", National Workshop on "Potential Participation on-board International Space Station for conducting Science Experiments"' held at Bangalore, July, 1999.

38) **S. C. Sharma**, S.K.Singh, P.P.Sinha and K.V.Nagarajan, "Characterization Practice Evolved for the Indigenously Developed Special Purpose Materials for Indian Space Programmes", National Seminar on Characterization of Materials, IIM Trivandrum Chapter, Trivandrum, Aug. 1998.

39) **S. C. Sharma**, S.K.Singh and P.P.Sinha, "Nanocrystalline Soft Magnetic Materials and Design and Processing of Fe-Ni Base Nano Alloys", National Seminar on "Nano Structured Materials", Kerala Centre, ISAMPE, Trivandrum, May 1998.

40) **S. C. Sharma**, S.K.Singh and P.P.Sinha, "Indigenous Development of a Constant Modulus Alloy for Space Applications", 51$^{st}$ ATM of the IIM, Jamshedpur, Nov.1997.

41) S.K.Singh, **S. C. Sharm**a and P.P.Sinha, "Processing Parameters and Property Development in Special Purpose Materials for Space Applications", 50$^{th}$ ATM of the IIM, New Delhi, Nov.1996.

42) **S. C. Sharma**, S.K.Singh and P.P.Sinha, "Nanocrystalline Soft Magnetic Materials", National Seminar on "Advanced Materials and Processing", IIM Trivandrum Chapter, Jan, 1996.

43) **S. C. Sharma**, P.P.Sinha and K.V.Nagarajan: "Disorder Entrapment in Drop-tube Processed $Ni_3Al$", 9$^{th}$ Annual Sym. on "Metallurgy and Materials Research", IISc, Bangalore, Oct, 1995.

44) **S. C. Sharma**, B.R.Ghosh, M.C.Mittal and K.V.Nagarajan, "Effect of Cooling Rate on Microstructural Features and Magnetic Properties of AISI 430 and 430F Stainless Steel", 41$^{st}$ ATM of the Indian Institute of Metals, Trivandrum, India, Nov. 12- 14, 1987.

# ANNEXURE-VIII

## Major Achievements

❖ **Led the teams for the following achievements during my professional career in Vikram Sarabhai Space Centre:**

**Establishment of Hafnium (Hf) Sponge Production Plant in the country**

▪ For Hf, an critical alloying element for C103 alloy-based nozzles for ISRO's launch vehicles and satellite programmes, a 300 kg-Hafnium Sponge Production plant is successfully established at CMET, Hyderabad with ISRO's financial support and technical collaboration,

▪ **As Chairman, Joint Project Monitoring Committee (JPMC) for this Project**, steered this activity during the stage of procurement, installation and commissioning. Presently, as **Chairman, JPMC** for the operational phase of the plant, is entrusted with the task of ensuring production/supply of Hf sponge meeting ISRO's requirements.

▪ ISRO has also established a EB Melting Facility at MIDHANI, Hyderabad for conversion of above Hf sponge to metal before alloying in C103. As **Chairman, JPMC** for this Facility, led to the successful establishment of the EB melting technology of Hf sponge in the country.

**Establishment of Niobium (Nb) Production Plant in the country**

▪ Nb, another critical alloying element for C103 alloy-based nozzles for ISRO's launch vehicles and satellite programmes, is presently imported.

▪ With ISRO's financial support and technical collaboration, a 3-Ton Niobium Production plant is under establishment at the Nuclear Fuel Complex, Hyderabad.

▪ **As Chairman, JPMC for this Project**, steered this activity during the very difficult phase of implementation and is currently leading the project to the successful final stage of installation and commissioning.

**Powder Metallurgy Products**

▪ Successful qualification of Metal Matrix Composite(Cu-Ni-$CaF_2$) Face Seals For Semi Cryo Engine

▪ Continued supply of Performance-critical double-layered Bronze Seal-Ring For CUSP and C-25

▪ Continued supply of Bronze Seal-Rings (4 types) for C-25 Cryo–turbo pump ▪

Respirational Cooling based W-Cu Nozzle Throat Inserts for Tri-propellant Engine

▪ Porous Loop Heat Pipes for Thermal Management of advanced Communication satellites and Mini Loop Heat Pipes based on Ni for interplanatery applications ▪ Very high modulus based 60%Be-Al Composite for Inertial Systems

**Investment Castings for Semicryo Project, C-25 Project and CUSP**

▪ Development, qualification and supply of 18 types of Investment Castings in Special Steels, Superalloys, Ti alloys and Al alloys for Semicryo Engine applications ▪ Continued supply of complex shaped 12 types of Investment Castings in superalloys, special stainless steels, titanium alloy and aluminium alloys for C-25 and CUS Projects

**AA2195 grade Al-Li Alloy for Cryo-tankage**

▪ Al-Li alloy, AA2195 offers tremendous potential for substantial weight saving as cryo tankage material for the next generation of TSTO based RLVs. Processing technology for AA2195 grade (Al-Cu-Li-Mg-Ag-Zr) aluminium alloy was first established at the laboratory in-house. Scaling-up of Lab scale processing technology to 700 kg level in industry was successfully done.

**Special Material Technologies**

- Metal to Ceramic (Al-$Al_2O_3$ and Cu-$Al_2O_3$: positive & negative electrodes) based terminal seals, a highly critical component of Li-ion Cell are successfully developed and qualified.
- Semi Solid Processing based Al alloy Housings for Electronic Packages are developed resulting into superior mechanical properties & improved yield.
- Diffusion bonding of Ti-5Al-2.5Sn-ELI alloy for LH2 fuel turbo pump impeller
- Brazing technology for a variety of brazing alloys and substrates for Semi cryogenic Engine

**Non-ferrous Wrought Products**

- Ti-alloy VT-14 Closed die forgings for aerospace mechanisms application in GSLV-MkIII
- Continued supply of Mg alloy based plates & forged blocks for Electronic Housing Packages for PSLV & GSLV
- Indigenised Forged and Extruded products in Al alloys for Semicryo Engine project

- Near-net Shaped forgings of Inconel 718 for composite gas bottle for Crew Module of HSP
- Extruded Dual-Core Al alloy Heat Pipes for Thermal Management System of Satellites

**Development of Green Technology for disposal of huge wastes of Ammonium Perchlorate (AP)**

- Huge AP wastes accumulated over decades, call for their environmentally safe disposal.
- Technology for bio-degradation of AP wastes was developed at lab scale in collaboration with CSIR labs and scaling up of the technology is in progress. ▪ As **Chairman of this collaborative project**, reviewed and guided development activities across various labs in the country.

**Development and induction of indigenous Li-ion cell technology**

- Design, development and supply of 5 Ah cells for GSLV MK-III, PSLV and GSLV flights and 100 Ah Li-ion cells for GSAT-29 satellite are successfully done. ▪ Satisfactory performance of 50 Ah Li-ion cells aboard GSAT-19 is achieved,
- Development and qualification of High power 5Ah Lithium ion cells for EMA application in S200 stage
- New Dry Room (0.4 RH class) for processing Lithium ion cells is installed and commissioned.
- Testing facilities are augmented by installing 48-channel cell cycling system.

**Scaling up of High Burn Rate Propellant**

- High Burn Rate propellant PEDCEM-86, an essential requirement of Crew Escape System, was successfully developed at Lab scale.
- Process technology was scaled up to 1200 kg level meeting the specified properties in association with other agencies in VSSC.

**High Temperature Materials based Products**

- Design, development and supply total 594 nos. (449 stand-alone complex configurations) of 3$^{rd}$ Generation Silica Tiles and 203 nos. (75 stand-alone complex configurations) of Flexible External Blankets for RLV-TD
- Alumina based cored bricks for 2$^{nd}$ phase of Hypersonic Wind Tunnel

- Metal/ceramic Graded Ignition Resistant Coatings for various systems of Semi cryogenic Engine

**Electronic Ceramic based Products**

- Miniaturised Titanates based PATCH and Dielectric Resonating(DR) antenna for IRNSS ground support systems
- Al and Mg Titanates based S-Band Dielectric Diplexer for satellite/LV applications

**Flight demonstration of indigenous Supercapacitor technology**

- In-house developed supercapcitor successfully performed on-board RH 200 flights. ▪ Indigenous supercapacitors have also been realized for application in SSLV. ▪ Hybrid variant of supercapacitor technology is also developed.

**Modified Insulation for cryo tanks**

- Modified foam-based insulation was successfully qualified and supplied for GSLV Mk-III and GSLV flights.

**Testing & demonstration of environmental friendly Inhibition system for Solid Motors**

- Asbestos free PEDIN-C Inhibition system for solid motors was developed and also static tested in motors.
- Productionization of PEDIN-C through industry is successfully done.

**Development of next generation Fuel Cell technology**

- A 100 W compact Fuel Cell (40 cell stack) successfully developed and tested.
- Fuel Cell systems for technology demonstration aboard PS4 Orbital platform is under advanced stage of realization.

**Igniter Grains for Crew Escape system of Gaganyaan**

- Design, development and qualification of igniter grains for Crew Jettisoning motor and Low Altitude Escape motor of Gaganyaan are successfully carried out.

**Polyimide pipelines for Cryo stages of GSLV MK-IIIand GSLV flights**

- 51 Polyimide pipeline profiles required for CUS and C25 applications, were processed in house as well through industry and supplied to GSLV MK-IIIand GSLV projects meeting critical requirements of schedule and performance.
- For automation of process, seven profiles are already realized and qualification is in progress. Code generation for remaining profiles is also in progress.

**Indigenous development of special Rubber Products for Semicryo project**

- Developed, qualified and supplied more than hundred sizes of O-rings based on rubber compositions derived from Nitrile, Fluro & EPDM for application in Semicryo project.

**SiC/C composite panels for Airbreathing Engine programme**

- Successful development, characterization and thermostructural testing of SiC/C composite panels processed through polymeric precursor route for thermal and mechanical loads typical to Airbreathing engine application is carried out.

**Development of Cyanate ester based composite Lunar Thermal Probe**

- Development, qualification and supply of high impact-strength Cyanate ester based composite Lunar Thermal Probe for Chandrayaan-2 mission are successfully carried out.

**VSSC Research Forum (VRF)**

- To catalyse research environment in VSSC, JRFs have joined Entities/Projects across the Centre for the first time. VRF was constituted mainly to synergize these research activities.
- Guided and steered the entire range of research process as **Chairman, VRF**.

**Steering of Advanced R&D and TDP Activities**

- Advanced R&D and TDP activities are the building blocks for technologies for the new and emerging programmes of ISRO. VSSC currently pursues 376 TDPs and Adv. R&Ds. 403 new TDPs and Adv. R&Ds are taken up this year.
- As **Chairman, VSSC Standing Committee for Review of Adv. R&D and TDP Activities**, put in major efforts for steering these activities in terms of meeting technological objectives and time-lines

# ANNEXURE-IX

## Technical Infrastructure Build-up

### PCM Production Hub

- Conceptualized and worked for successful approval of PCM Production Hub for in-house processing of project-critical but commercially unviable low volume polymeric products, enabling scientific manpower of PCM to focus on the development of newer products.
- Realisation process for equipments and building has begun.

### Setting up of Major Labs/Facilities

- All necessary approvals and clearances for the following two major Labs/Facilities of PCM Entity are obtained and procurement of equipments and process for realization of building have started:
  - Fuel Cell Laboratory
  - Pilot Plant for Supercapacitors

### Installation, Commissioning & Operationalization of Hot Isostatic Press Facility (HIP Facility)

- To enhance the reliability of investment castings by annihilating the defects and to process the high and ultra high temperature ceramics and composites, a prestigious HIP facility with capability of achieving process parameters upto 2000 bar & 2000 $^0$C, was successfully installed and commissioned. Realized mostly through indigenous resources, the HIP is great value in meeting the above objectives.**(Contract Manager, HIP Facility)**

### Installation and Commissioning of important Equipments

- Led the teams for successful installation and commissioning of following major processing and characterization equipments**:**
  - Field Emission Scanning Electron Microscope (FE-SEM)
  - SOFI– Spray machine for polymeric foam products
  - In-situ robotic fluid dispensing system for form-in-place sealing of fuel cells,
  - Catalyst characterization system,
  - Vacuum Brazing Furnace for joining of ceramics to metals,
  - Steam based phenol melting oven,
  - Solvent storage & handling facilities for Isopropyl Alcohol & recovery plants,
  - 50 TR chilling plant for HTPB production process
  - Plasmod Generator for evaluation of atm.$O_2$ resistance of space materials
  - Lab scale catalytic packed bed reactor for studies on $CO_2$mitigation in ECLSS

- Industrial rotavapour and Non-IBR boiler (steam),
- Nitrogen Generator for CVI facility,
- Augmentation HTPB Production Facility
- Biaxial Strain Measurement M/c
- Impulse Excitation M/c
- High Temperature Mechanical Testing Unit
- Vacuum Heating Furnace and Mini Hot Press
- Thermomechanical Fatigue Testing Machine

**ANNEXURE-X**

## Technology Transfers to Industries

- **Guided the Teams for successful transfer of following technologies to the industry:**

- Technology of EPIFIL transferred to M/s Atul Industries, Mumbai -

Technology of SILCEM R9 transferred to M/s Rubfila, Kochi

- Technology for "Umbilical Pads" transferred to M/s Sriram Foams Pvt Ltd., Chennai
- Technology for "Space grade Li-ion Cells" transferred to M/s BHEL, Bangalore, and
- Technology for "EPIFIL 9661" transferred to M/s Pidilite Industries, Mumbai
- Technology for "Pedcoat Liner System" transferred to M/s Atul Industries, Mumbai
- Technology for "Li-ion Cells" transferred to SIX industries :
    - M/s NALCO,
    - M/s Exicom Systems Pvt. Ltd.,
    - M/s Amararaja Batteries, Tirupati,
    - M/s Thermax Ltd. Pune,
    - M/s Caborundum Ltd. Pune,
    - M/s Tata Chemicals, Mumbai

# ANNEXURE-XI

## Important Technomanagerial Responsibilities held

- **Chairman**, **Joint Management Committee of ISRO-IISc** Centre of Excellence on Advanced Mechanics of Materials at IISc, Bangalore
- **Co-chair(alongwith Director, IIT, Delhi), Joint Policy Committee,** ISRO-IIT Space Technology Cell at IIT, Delhi.
- **Co-chair(alongwith Director, IISc, Bangalore), Programme Review and Advisory Committee (PRAC)** for the **ISRO-IISc Projects** at the **Centre for Nano Science and Engineering (CeNSE)** at **IISc, Bangalore**
- **Chairman, VSSC Research Forum** (VRF)
- **Co-Chairman,** ISRO Centralized Recruitment Board (Mechanical)
- **Chairman** of **VSSC-CMET(Hyderabad)Joint Project Monitoring Committee (JPMC)** for project, "Development of Carbide derived carbon (CDC) Materials"
- **Chairman**, **JPMC** for MoU with CSIR Labs IMTech, Chandigargh and IITR, Lucknow for "Development of Microbial Resource/Consortia for Biodegradation of Ammonium Perchlorate".
- **Chairman, VSSC Standing Committee** for Technology Development and Advanced R&D Programmes.
- **Chairman, Joint ISRO-DAE Project Monitoring Committee (JPMC)** for the Project "Establishment of first Niobium (Nb) Production Plant at Nuclear Fuel Complex, Hyderabad in the country"

- **Chairman**, **Joint VSSC-CMET Project Monitoring Committe**e (JPMC) for the Project "Hafnium (Hf) Sponge Production Plant at Hyderabad".
- **Chairman**, Post Flight Analysis (PFA) Committee – Thermal Protection Systems & C/C Elements, RLV-TD HEX – 01 Mission
- **Chairman,Academic Committee, VSSC**
- **Chairman,** VSSC Editorial Board
- **Chairman,** VSSC Search committee for Group Directors/Heads/Div. Heads posts
- **Alt. Chairman**, VSSC Recruitment Council (VRC) (Associate Member)
- **Chairman**, Intellectual Property Rights Monitoring and Co-ordination Committee (IPRMCC), VSSC
- **Chairman**, Standing Review Committee for Centre of Excellence on Adv. Mech. & Mat. established by ISRO at IISc, Bangalore
- **Chairman**, VSSC-CUSAT (Kochi) Research Committee for Ph.D. registrants from VSSC at CUSAT, 2016-20.
- **Chairman,** Price Review Committee for Zr Scrub Raffinate supply from NFC for Nb production at CMET, Hyderabad,
- **Chairman,** Production Capacity Assessment Team for procurement of Rayon based Carbon Fabric from industry, 2019
- **Chairman**, Design Review Team (DRT) for Development Projects (Materials & Manufacturing), VSSC
- **Chairman,** Committee for 'Realization of Investment Castings for CUSP and C-25

Projects', MME, 2011-14.

- ❖ **Chairman,** PDR Committee for Hot Isostatic Press(HIP) Facility,2009-11
- ❖ **Chairman**, Technical Advisory and Review Committee for Data Generation & R&D work on Al alloys, MME, 2013-15.
- ❖ **Chairman**, Standing Review Committee for Metallurgical Failure Analysis (SRC-MFA, MME), 2014-16.
- ❖ **Chairman**, Technical Advisory Committee for Ignition Resistant Coatings for Semicryo Engine, 2013-16.
- ❖ **Chairman**, Sponsored Research Co-ordination and Review Team (MME), 2011-16.
- ❖ **Chairman**, Tech. Advisory & Review Committee (TARC) for Scaling up of Al-Li Processing Technology, MME, 2013-15
- ❖ **Chairman,** Technical Evaluation Committee for Procurement of Ultra Nano-Indentation unit with AFM (IISU), 2015
- ❖ **Chairman,** NCRB-A Sub Committee on Materials & Fasteners (2009- 14)
- ❖ **Chairman**, Expert Committee on "Defects Analysis and Identification of Corrective Actions for S200 Motor Cases", 2012-14.
- ❖ **Chairman**, VSSC Committee to Plan, Review, Monitor and Implement Young Scientists Programme of ISRO (YUVIKA), 2020
- ❖ **Alt. Chairman**, Senior Purchase Committee, CFC-II & CFC-III
- ❖ **Chairman**, Jr. Purchase Committee (JPC-03), 2017-19.
- ❖ **Chairman**, VCMC Sub-committee for reviewing proposals for external training

programs

- ❖ **Chairman**, Core Organising Committee-Inter Centre Hindi Seminar – 2020
- ❖ **Chairman,** Organizing Committee, Hindi Kavi Sammelen on "National Integration" in VSSC, Sept. 2017
- ❖ **Chairman**, VSSC Standing Committee for Screening of Awards,
- ❖ **Chairman**, Committee for vetting Hindi content on Internet Website,
- ❖ **Chairman**, Vikram Sarabhai Hindi Maulik Pustak Lekhan Scheme
- ❖ **Chairman**, Implementation and Overviewing Committee (IOC) of VSSC Duty Officer System.
- ❖ **Chairman**, Transport Advisory Committee
- ❖ **Chairman**, Apex Committee for Security (IT Services & Electronic Gadgets)
- ❖ **Chairman**, Content Review Committee for proactive disclosure of information under RTI Act, 2005
- ❖ **Alt. Chairman**, ISRO Steering committee for Indigenization of Space Materials,
- ❖ **Alt. Chairman**, JPMC for ISAC-SIRTA MoU for setting up the TRCOT Knitting Facility for Large Aperture Unfurlable Space Antenna, 2014-16
- ❖ **Alt. Chairman**, Spacecraft Systems Clearance Board (SSCB), VSSC, 2018-19
- ❖ **Alt. Chairman**, Technology Transfer, Marketing & Commercialization Committee (TTMCC), VSSC
- ❖ **Alt. Chairman**, Public Procurement Evaluation Committee, VSSC
- ❖ **Alt. Chairman**, Editorial Board-PROMOCHAN, Quarterly Bi-lingual Bulletin of

VSSC, (upto April 2020)

- **Alt. Chairman**, Selection Committee for Sci/Engr 'SC'
- **Member**, Technical Evaluation Committee for RFQ proposals for technology transfer of Li-ion cells,
- **Member**, Centre-level Review Committee for "Advanced research activities under Energy Systems Area",
- **Member,** Payload Review and Clearance Board (PRCB) for payloads aboard Chandrayaan-2 Mission,
- **Member,** Apex Committee for "Outreach of Innovative Space Technologies for Societal Applications
- **Member**, Expert Review Committee "Development of composite solid propellant combustion model", VSSC
- **Member**, Inter Centre committee to assess space Debris collision and shielding requirements for Gaganyan"
- **Member,** APEX Rev. Committee for Dev. of Radioisotopic based Space Power Systems
- **Member**, PMB, Semicryo Propulsion Systems Project
- **Member,** Overall Review Committee (ORC) for SSLV Systems,
- **Member**, Centralized Screening and Selection Committee for Asst. Engrs., ISRO Hq
- **Member,** Apex Committee for realization of space grade Li-ion cells and batteries through BHEL
- **Member**, RESPOND Steering Team (VSSC)

- **Member,** Official Language Incentive Committee
- **Member,** Centre- level Review Committee for Semicryo Systems from VSSC
- **Member**, VSSC, Official Language Implementation Committee (OLIC)
- **Member**, **Joint Policy Committee, ISRO-IIT Space Technology Cell at IIT, Kharagpur**, (2012 to 2017)
- **Member**, VSSC Management Council

# ANNEXURE-XII

## Contributions to the Professional Field

❖ **Chairman**, Organizing Committee, Int. Conf. "Advanced Thermostructural Materials and Thermal Protection Systems (ADTHERMS'20), MRSI Trivandrum Chapter, Jan 19-21, 2020.

❖ **Chaired the Panel Discussion** on "Materials and Processing Technologies" in the Summit Vaibhav organised by Government of India to develop mechanism for involving Indian diaspora working in R&D and academic institutions across the world alongwith acedemicians/scientists in the country to further the knowledge base of Indian research and academic institutions, October 07, 2020.

❖ **Chairman,** Technical Committee, Int. Conf. "Advanced Aerospace Materials & Processes" (ADMAT-2017), organized by ISRO at Trivandrum in Dec. 13-15, 2017.

❖ **Chairman**, Organizing Committee, National Workshop, "Towards Self Reliance in Electronic Ceramics for Strategic Applications". (ACer-2016) organized by INAE & VSSC, Trivandrum, July 2016.

❖ **Chairman**, Theme Symposium on "Nov. 2014. Materials for Space" during Annual Tech. Meet of the Indian Institute of Metals at Pune, Nov.14-17, 2014

❖ **Chairman**, Organizing Committee, Int. Workshop on "High Temperature Materials and Hot Structures"(HTMHS-2013), IIM Trivandrum Chapter, Feb.7-9., 2013.

❖ **Chairman**, Organizing Committee, Int. Conf. "Advances in Metallic Materials and Manufacturing Processes for Strategic Sectors", (ICAMPS-2012), IIM Trivandrum Chapter, Jan. 19-21, 2012.

❖ **Chairman,** Organizing Committee, National Seminar on "Special Purpose, Strategic and Futuristic Materials for High Technology Sectors", IIM, Trivandrum , Feb. 27, 2006.

❖ **Chairman**, Indian Institute of Metals, Trivandrum Chapter, 2007-08, 2008-09.

❖ **Co-chairman**, Organizing Committee, Int. Conf. 'Advanced Materials and Manufacturing Processes' (ICAMPS-2018), by Indian Institute of Metals at Trivandrum, Oct. 2018

❖ **Co-Chairman**, Organizing Committee, National Metallurgists' Day (NMD) and Annual Technical Meeting (ATM) of the Indian Institute of Metals (IIM), Nov. 2019

❖ **Co-Chairman**, Organizing Committee to commemorate 50th anniversary of indigenous solid propellants development and for colloquium on "Solid Propellants –Past, Present & Future", VSSC, 27th Feb. 2019

❖ **Co-Chairman**, Organizing Committee, National Seminar on "Advances in Nano, Metal and Ceramic Composites", IIM Chapter, Trivandrum, Feb. 2005

❖ **Co-Chairman**, Organizing Committee, National Seminar on "Advanced Materials for Hostile Environment: Present Scenario & Future Perspectives", IIM, Trivandrum Chapter, March 2007.

❖ **Vice-Chairman**, Indian Institute of Metals, Trivandrum Chapter, 2005-06, 2006-07.

❖ **Convener**, Organizing Committee, National Seminar "Recent Trends in Solidification Technology" VSSC, Trivandrum, Aug.2008.

❖ **Member,** Sectional Committee-VIII of Indian National Academy of Engineering (INAE) on Mining, Metallurgical and Materials Engineering

❖ **Member,** Governing Council, High Energy Materials Society of India (HEMSI),

❖ **Dept. of Space representative** in the Nano Inter Agency Group (NIAG) of Nano Mission under Department of Science and Technology (DST).

❖ **Member**, Joint Policy Committee of ISRO-IIT Kharagpur -- Space Technology Cell, 2012-18

❖ **Member**, DRDOs Peer Review Committee for Project "Materials and Manufacturing process for long duration Hypersonic Cruise and Glide vehicles".

❖ **Institutional Representative (VSSC**) in Indian Institute of Materials Management,

❖ **Lead-official** for Working Group -21 constituted by ISRO Hqrs. for focussed interaction with various Ministries/Depts. under initiative on "Space Technology based tools in governance & development",

❖ **Member**, International Astronautical Federation's Technical Committee on "Microgravity Sciences and Processes", 1989-2003.

❖ **Member**, National Microgravity Research Program (NMRP) constituted by ADCOS/ISRO HQ, 2001-10.

❖ **Convener,** Special Plenary Session on "Microgravity Science, Technology and Applications", 14th Space Science Symposium, Ooty, Feb.2009 by ADCOS.

❖ **National Coordinator** of the Special Interest Group Meet on Microgravity, 14th National Space Science Symposium, Ooty, Feb.2009 by ADCOS.

❖ **Chief Editor**, PROMOCHAN, the quarterly Bi-lingual Bulletin of VSSC

❖ **Faculty**, Structured Training Programme, HRDD, VSSC

❖ **Member,** Advisory Council for Beryllium Facilities(Joint Council of DoS & DoAE)

❖ **Life Member**, Materials Research Society of India (MRSI)

❖ **Membe**r, Indian Ceramic Society

❖ **Member,** Indian Institute of Metals

❖ **Member,** Society for Polymer Science in India

# ANNEXURE-XIII

## Association with Indian Institute of Space Science & Technology (IIST, Trivandrum)

- **Chairman**, VSSC-IIST Joint Project Monitoring Committee for reviewing VSSC-JRFs registered for Ph.D. at IIST
- **ISRO Guest Faculty** for course on "Special Materials" for M. Tech. (Chem.) students (for the year 2011)
- **Invited Expert** on **Board of Studies** for M. Tech. in Materials Science and Technology, Indian Institute of Space Science and Technology **(**IIST), Trivandrum, (since 2018)
- **Member**, Screening Committee for DPC review process for IIST faculty members(since 2017)