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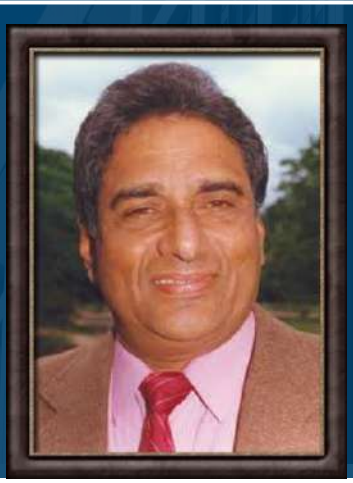

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Dr. Placid Rodriguez Memorial Lecture - 2026

on

Design & Manufacture of Multi Layer Materials and Components for High Heat Flux Components

***Padma Shri.* Dr. K. Balasubramanian**
Distinguished Scientist & Director
Nonferrous Materials Technology Development Centre
Hyderabad

Monday | 05 October 2026 | 15:00 hrs

Central Lecture Theatre (CLT), IIT Madras, Chennai

Zoom Meeting details

Meeting ID: 943 2299 4815 | Password: 1234 | Link

Dr. Placid Rodriguez Memorial Lecture - 2026

About PRML

Dr. Placid Rodriguez, born in Quilon, Kerala on October 5, 1940, obtained his B.Sc.from Kerala University, B.E.(Metallurgy) from the Indian Institute of Science, Bangalore, M.S. from University of Tennessee, USA, Ph.D. from IISc and MBA from IGNOU. He joined the Department of Atomic Energy in 1960 and moved to The Indira Gandhi Centre for Atomic Research, (then known as Reactor Research Centre) in 1974. He established one of the leading metallurgical research laboratory at Kalpakkam. He was Director of IGCAR, Kalpakkam from 1992 to 2000. Subsequently he served as the Chairman, Recruitment and Assessment Centre, DRDO, Delhi and Raja Ramanna Fellow and AICTE-INAE Distinguished Visiting Professor at IIT, Madras.

Dr. Placid Rodriguez had an exemplary career of four decades, leading research in metallurgy, materials development for fast reactor programme of our country, shaping up human resources in defence programme and academic institutions. Dr. Placid Rodriguez has been a member of Editorial Board of several reputed international journals in Metallurgy and Materials Science and was the Chief Editor of Transactions of The Indian Institute of Metals. Dr. Placid Rodriguez served as the President of many leading national, professional institutes. Dr. Placid Rodriguez has been a recipient of many national and international awards. He has been a Fellow of many prestigious Academies of our country.

Dr. Placid Rodriguez passed away in Chennai on 31st August, 2008.

Previous Placid Rodriguez Memorial Lectures have been delivered by

- **Prof. Atul Chokshi,** Indian Institute of Science, Bangalore (**2009**)
- **Prof. Seeram Ramakrishna,** National University of Singapore (**2010**)
- **Dr. Srikanth,** Director, NML, Jamshedpur.(**2011**)
- **Prof. B.S. Murty,** IIT Madras, Chennai (**2012**)
- **Prof. Indranil Manna,** Director, IIT Kanpur (**2013**)
- **Dr. Amol A. Gokhale,** Director, DMRL Hyderabad (**2014**)
- **Dr. G. K. Dey,** Associate Director, Materials Group, BARC, Mumbai (**2015**)
- **Dr. A.K. Bhaduri,** Director, IGCAR, Kalpakkam (**2016**)
- **Dr. U. Kamachi Mudali,** Chairman & Chief Executive, HWB, Mumbai (**2017**)
- **Dr. Samir V. Kamat,** Director General, (Naval Systems) DRDO(**2018**)
- **Shri. S. Somnath,** Director, VSSC, ISRO, Trivandrum (**2019**)
- **Dr. Surya R. Kalidindi,** Georgia Institute of Technology, Atlanta, USA (**2020**)
- **Dr. B. Venkatraman,** Director, IGCAR Kalpakkam (**2021**)
- **Dr. Debashish Bhattacharjee,** TATA Steel (**2022**)
- **Dr. Komal Kapoor**, Chairman & Chief Executive, NFC, Hyderabad (**2023**)
- **Dr. S.K.Jha**, Chairman & Managing Director, MIDHANI, Hyderabad (**2024**)
- **Dr. Raghvendra Tewari**, Director, Materials Group, BARC, Mumbai (**2025**)

Dr. Placid Rodriguez Memorial Lecture - 2026

Padma Shri. Dr. K. Balasubramanian

Distinguished Scientist & Director

NFDTC, Hyderabad

Curriculum Vitae

Dr K Balasubramanian, graduated from the Indian Institute of Technology (IIT), Kanpur, India with a B. Tech in Metallurgical Engineering in 1982. He proceeded to the School of Materials Science and Engineering at McMaster University, Canada to pursue a direct PhD on being awarded the ALCAN fellowship.He specialized in thermodynamics of Materials and Thermo-kinetics of processes, process development and optimization during his doctoral research. He continued research and teaching at McMaster till 1990.

Dr Bala returned to India in 1990 to take up the opportunity and challenge of setting up a unique Materials Tech Centre in India called the NFTDC, the Nonferrous Materials Technology Development Centre. Dr Bala the technical and managerial leadership for this unique R & D institution which is a self-financing centre and only one of its kind in India as non-grant in aid autonomous R & D institution under GOI. He rendered NFTDC as a Technology Centre which is multi-disciplinary knowledge domain institution to undertake complex technology development endeavors as interdisciplinary projects involving both knowledge creation (scientific know-why) and knowledge integration (technical knowhow) over TRL 3 to 8 Spectrum. He brought in knowledge expertise in development of advanced materials, innovative processes on the one hand and but also mechanical design, analysis, electronics, instrumentation and control leading to component and systems development & integration on the other which made NFTDC a one of its kind institutions in Technology Space. He has been serving as its first director for the last 27 plus years and is continuing in that position.

Dr Bala's research interests in the last 40 years span into end-to-end Technologies materials, processes and application engineering. He is known for his research on (i) Innovative Processes and Advanced Materials; (ii) Product and Technology Developments in End-to-End Solution Paradigms up to plant level; (iii) Interdisciplinary R&D, Knowledge Integration and Knowledge Management; (iv) Pattern Recognition and Complexity in Organizational Systems Behaviour; (v) R & D Policy.

Dr Bala has set up many centres of excellence as in (i) CoE for advanced materials & processes; (ii) CoE for Engineering Design and Manufacturing (aerospace, aeronautical & biomedical); (iii) CoE for Electric Vehicle Technologies; (iv) CoE for Biomedical Devices and (v) CoE for Materials and Energy Devices. Dr Bala and his team at NFTDC were responsible for conceiving and rendering many advanced materials for cryo engine development for the Chandrayan, Mangalyan and Gaganyan missions. Presently, he is leading projects in national programs on Critical Materials (NCMM), Hydrogen systems, Critical Materials, Electric Vehicles including the India's first Rare Earth magnet plant.

Dr Balasubramanian has been given the distinguished scientist grade, being one of the youngest then with that honour in the country. He has published over 100 papers in international journals, and has guided many for PhDs in materials, processes, pattern recognition, knowledge management and reconstructive surgery which are of interdisciplinary nature. He has won many awards and laurels for his contribution to Science and Technology. Brief Above all, Dr Bala is an institution builder and has trail blazed and demonstrated a live and working model of an autonomous, self-financing R & D institution. Recently Dr Balasubramanian (2026) has been conferred Padma Shri in Science & Engineering category for his contributions in national missions and institution building to cater to high technology endeavours.

Design & Manufacture of Multi Layer Materials and Components for High Heat Flux Components

Padma Shri. **Dr. K. Balasubramanian**
Distinguished Scientist & Director
NFDTC, Hyderabad
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Abstract

High Heat Flux (HHF) components are crucial functional members in aeronautical and aerospace (Cryo engine - Launch Vehicle), fusion reactor (ITER) applications. They fall under three categories, namely (i) engine components, (ii) leading edge or frame components and (iii) front wall plasma facing components (ITER). Engine components in aircraft have been dominated by nickel base super alloys and of late a few ceramic composite materials have made foray in to this select application space. Engine components in aerospace systems have been based on advanced high strength-high conductivity copper based alloys as thrust motors for both launch vehicle and satellite position correction (steering engines). The frame and leading edge structures are very different for aeronautical and aerospace systems. In the case of former, aluminium alloys have been the mainstay. For hyper sonic flight systems, active cooled aluminium and titanium alloys along with carbon /carbon composites are the candidate materials for making components to withstand heat flux at mach 2.5 and above.In the case of aerospace systems, particularly the re-entry systems such as space shuttle, the need for thermal barrier and oxidation resistant tiles are paramount. The solutions are in highly porous refractory materials such as silica tiles and carbon based materials for nose cones.

Plasma facing components (ITER) comprise of refractory metal (W) or C/C tiles superimposed on high thermal conductivity copper alloys with interface layers serving as large area bonding systems.These components have to withstand more than 15-20 MW/sqm heat flux in neutral beam injection lines as well as extract part of the heat from diverter segments.

This lecture will discuss the design and processing of materials such as advanced copper alloys, nano-porous tungsten and surface engineering of carbon materials. The processing of these materials are fairly complex and materials to components graduation is the key to successful development. These materials and their intrinsic strength vs thermal properties in terms of high thermal conductivity or high thermal resistance together with surface modification for oxidation resistance will be elucidated in terms of materials design, process design and process – product integration and optimization.

Dr. Placid Rodriguez Memorial Lecture - 2026

PROGRAMME

Venue: Central Lecture Theatre (CLT)
IIT Madras, Chennai

Time & Date: 15:00 hrs, 5 October 2026

Zoom Meeting ID: 943 2299 4815 Password: 1234
Zoom Link

Welcome Address	**Prof. Sushanta Kumar Panigrahi** *Chairman, IIM Chennai Chapter*
Special Address	**Prof. V.S. Sarma** *Head, Dept. of Metallurgical & Materials Engineering, IIT Madras*
About Dr. Placid Rodriguez	**Dr. V. Karthik** Convener, PRML
About PRML Series	**Dr. Anish Kumar** *Chairman, IIM Kalpakkam*
Presidential Address	**Prof. Prathap Haridoss** *Dean of Academic Courses, IIT Madras*
Introducing PRML Speaker	**Dr. K.G. Pradeep** *Vice Chairman, IIM Chennai Chapter*

18th Dr. Placid Rodriguez Memorial Lecture

***Padma Shri*. Dr. K. Balasubramanian**
Distinguished Scientist & Director
Nonferrous Materials Technology Development Centre (NFTDC)
Hyderabad

Design & Manufacture of Multi Layer Materials and Components for High Heat Flux Components

Vote of Thanks	**Shri. Narayanan Perumal** *Hon. Joint Secretary, IIM Chennai Chapter*

High Tea and Interactions

Program Moderator: **Dr. Surendra B Anantharaman**
Hon. Secretary, IIM Chennai Chapter