



# IAF Committee Briefs

Winter 2024

## IAF MATERIALS AND STRUCTURES COMMITTEE

### Introduction

The IAF Materials and Structures Committee was established more than three decades ago. The Materials and Structures Symposium, coordinated by the Committee, provides an international forum for recent advancements and assessment of the latest technology achievements in space structures, structural dynamics, and materials, classically concerning space transportation, space vehicles and orbital infrastructures. Currently, the IAF Materials and Structures Committee is composed of about 40 members, among which more than 30 are strictly involved in the annual organization of the IAC congresses.

### Summary

As the whole space sector, the field of materials and structures is undergoing constant evolution and advancements. Over the last years, an increasing trend towards further miniaturization of satellites and the development of small launchers has been observed. Cost-efficient, sustainable, and reusable space transportation solutions as well as in orbit manufacturing and assembling technologies have been discussed as prerequisite for a commercial use of the LEO ecosystem. Lightweight design is continuously evolving through use of new materials, new production technologies and through advancements in computational optimization approaches. An evolution of the clean space initiative has been observed, involving advancements in efficient structures, mechanism designs as well as robotic orbital support services. Eco friendly designs and reusability play a key role for clean space.

The advancement of additive manufacturing techniques furthermore enabled the utilization of custom-tailored composites and engineered materials to maximize the performance of future structures and to enable their multi-functionality. At the same time, an ongoing growth in small satellite structures and mechanical devices has been noticed, including antennas booms, gravity gradient, stabilization, temperature control and solar panels

### Highlights

One of the highlights in the field of materials and structures is the unlimited possibilities enabled by serial additive manufacturing and intelligent automation. This, for example, enables multi-scale optimization and manufacturing of, for example, ultra-lightweight structures consisting of optimized macro geometries and tailored lattices on a meso-scale level. Combined with smart materials and deployment mechanisms, such innovative concepts and designs are currently being investigated for upcoming robotic landers and rovers. All these new developments have been widely presented and discussed in this year's IAF Materials and Structures symposium confirming their high importance to the space community.

### Future Outlook

Rapid advancements and innovative developments in the space sector are constantly driving its evolution, leading to a shift in discussions around its key topics. The Materials and Structures Committee is actively keeping pace with these transformative changes and updated the Symposium organization with new topics in view of the next congress in Milan.

Session	Session Name	Focus
C2.1	Space Structures I Design, Development and Verification <i>(Launch Vehicles and Space Vehicles, including their Mechanical/ Thermal/ Fluidic Systems)</i>	Design, development and verification of space launch structures and systems
C2.2	Space Structures II Development and Verification <i>(Orbital deployable and dimensionally stable structures, including mechanical and robotic systems / subsystems)</i>	All aspects of deployable and dimensionally stable structures
C2.3	Space Structures III Design, Development and Verification <i>(Orbital infrastructure for in orbit service &amp; manufacturing, Robotic and Mechatronic systems, including their Mechanical/ Thermal/ Fluidic Systems)</i>	Orbital infrastructures design, development and verification, including their mechanical/ robotic/thermal/fluidic systems
C2.4	Space Structures Control, Dynamics and Microdynamics	Dynamics, control, analysis and testing of space structures, including robotic/ mechatronic systems
C2.5	Space Structures and Materials for Extreme Environment <i>(High-temperature and cryogenic-temperature applications including thermal insulation concepts)</i>	Extreme environments, including both cryogenic and high temperature applications in space related domains.
C2.6	Space Environmental Effects and Spacecraft Protection	Space environmental effects and spacecraft protection.
C2.7	Manufacturing and industrialization for Launch Vehicle and Space Vehicle Structures and components <i>(High volume production, industrialization, automatization and digitalization)</i>	Manufacturing, inspection and testing technologies to enable efficient high-volume production for launch vehicle and spacecraft structures.
C2.8	Advancements in Materials Applications, Additive Manufacturing, and Rapid Prototyping Manufacturing and Rapid Prototyping	Advancements in materials applications, rapid prototyping, and materials and processes for in space manufacturing and construction.
C2.9	Smart Materials and Adaptive Structures & Specialized Technologies, Including Nanotechnology	Application of smart materials, Specialized material and structures technologies

The Committee's aim is to organize a technical meeting or round table to introduce the new organization of the symposium to a broader audience.

### Committee Activities



Each year the Materials and Structures Committee honors scientists or engineers for their outstanding research and innovations in the field of Materials and Structures for space applications through the Paolo Santini Memorial Lecture.

The Paolo Santini Memorial Lecture at the IAC 2023 in Baku was held by Professor Harijono Djojodihardjo.

The technical presentations presented in the Materials and Structures Symposium during the IAC Congresses have always reached a large audience in the scientific community, so much, that the Symposium is one of the most followed within the IAC. For the current year, the IAF Materials and Structures Committee will propose some initiatives to involve researchers and engineers from new emerging countries in the aerospace sector.