

2019 National Space and Missile Materials Symposium and Commercial and Government Responsive Access to Space Technology Exchange

Session Write-Ups:

Additive manufacturing for Space and Missile Materials

This session focuses on recent developments in additive manufacturing (AM) methods and production of materials for diverse aerospace applications including structural, thermal management, and propulsion components. Development of new AM materials (monolithic, graded, composites, or coatings) and methodology for space and missile applications and materials development methodology are addressed. Additional areas covered include the results of design and development of AM processed components, post processing heat treatments, residual stresses, in-situ monitoring, integrated computational and materials engineering tools, and database development and processes for assessment. The session covers the non-destructive inspection, In Space Manufacturing (ISM) initiative with specific topics such as ISM, 3D Plastics Printer results, Additive Manufacturing Facility (AMF) characterization data, refabricator status, ISM metals updates, any of the common use materials, and additive manufacturing of primary structures made in space.

Ground Test & Evaluation

This topic area focuses on the development & utilization of ground test facilities to support material technology development. Significant investment is currently being applied to the revitalization of the national test infrastructure. The renewed interest in hypersonics, as well as space access has resulted in the identification of gaps in the available test infrastructure. The Aerospace Community has recognized these gaps and has invested funding to improve the test capability supporting flight and space system material development. These investments are focused on risk reduction to ensure technology maturation is adequately accomplished prior to flight demonstrations and fielding. Topic covered at this session include testing with respect to: hypersonic materials, aerothermal, combined thermostructural effects, weather encounter, and nozzle material development.

Emerging Materials and Novel Processing Technologies

This session addresses emerging materials innovations in four major areas: Ceramic Matrix Composites (CMCs), CMC Modeling, Ultrahigh Temperature Composites (UHTCs), and ablative thermal protection materials (TPMs).

Hypersonics

This session addresses hypersonic systems and requirements, component testing; leading edges and nose tips; acreage TPS and hot structures; and windows/apertures. Talks will cover these areas including analysis, materials, processing, manufacturing, and test.

Missiles & Missile Defense

This session covers the use, testing, analysis, and fabrication of materials, structural concepts, and propulsion technology for missiles and missile defense. Other topic areas include materials and material

processes that support missile defense, strategic systems, tactical missiles, high energy kinetic projectiles, and re-entry systems for military applications. Topics include missile material/component performance, properties, analysis, and material producibility; ground- and flight-test materials evaluations; and material manufacturing advancements and innovative techniques. Program and system overviews with pertinent materials issues and updates related to current missile programs will also be included. Focus areas include development and ground/flight testing of missile thermal protection systems, structural insulators, axial rocket motors and propulsion control system materials, and material technologies for novel propulsion systems (excluding propellants).

Mission Operations and Experiments in Space

This session addresses key space technologies including advanced materials, novel designs, new sensors, space experiments for current and future space missions/operations and planetary exploration focusing on components and environmental effects in space or simulated on the ground. Space operation technology interests include thermal control systems, sensors, and other payload materials. Exploration technologies for atmospheric entry, landing, and surface operations including ablative thermal protection materials will also be addressed. This session also includes computational modeling, ground testing in space environmental simulation chambers, and testing in space.

Space Access & Propulsion

This session addresses space propulsion critical materials and processing technologies enabling access to space, including single use or reusable crewed and robotic launch and orbital boost systems. Topics include innovative structures and designs, materials and processes, and manufacturing fabrication concepts for launch vehicle and in-space propulsion system structures, propellant tanks, engine systems, solid and liquid rocket boosters, and thermal management/protection systems.

Responsive Access for Pico/Nano/Small Payloads

This session includes existing and emerging platforms for delivering small payloads and experiments into their desired location (high altitude, sub-orbital or orbital environments). This would include concepts for novel use of vehicles such as a flying testbed. The session focuses on near term capabilities in development for delivering payloads up to 1000 lbs into the desired environment for less than \$5M per launch. This session includes requirements and understanding of projected payloads, orbits, and capabilities of emerging systems as well as technical challenges. This session also includes government practices, programs, and technologies which potentially benefit the emerging sub-orbital and small launch industry.

Reducing Cost, Increasing Safety, and Improving Reliability

This session covers concepts and/or progress in developing low cost (or lower cost) subsystems, systems or architectures that will help increase safety and/or flight rate of launch (orbital and sub-orbital), and future "commercial aircraft like" re-entry. Topics include, but are not limited to, non-toxic propellants/monopropellants, minimization of launch and re-entry noise, improved noise modeling of launch and re-entry operations, subsystem and vehicle integrated health management systems, and associated sensors for severe environments. This session also includes increased reliability and public safety, as well as safety of crew and other occupants for manned vehicles.

High Altitude/Sub-Orbital Experiments and Capabilities

This session addresses lessons learned and information gathered from recent flight test experiments on high-altitude balloons and sub-orbital rockets as well as overviews of future near term experiments. This includes both commercial and government platforms, as well as capabilities for future test and upgrades. Lessons learned may include test conduct, safety, and mission performance.

Emerging Propulsion Systems

This session addresses industry and government propulsion development programs that can support future responsive space access needs. The topic includes traditional rocket engines and emerging technologies to develop lower cost propulsion solutions for small (<1k lb), medium (1k - 10k lb) and large (10k+ lb) orbital payloads. This includes rocket engines and propulsion technologies that can be used in support of the next generation of Evolved Expendable Launch Vehicles (EELV), reusable boost system architectures, low-cost expendable engines (experimental demonstrators and emerging operational systems), modularity, and propellant development.

Emerging Entry, Descent and Recovery Systems and Technologies

This session covers emerging concepts to permit safe, low cost, efficient recovery of on-orbit payloads. Included are reusable upper stages, fairing recovery, and unique CONOPS approaches as well as related recent or near-term flight test activities. This discussion topic covers mission need, system description, uniqueness, and roadmaps towards developing the capability.

Integrated Vehicle Health Management (IVHM) & Integrated Systems Health Monitoring (ISHM)

The Integrated Vehicle Health Management (IVHM) / Integrated System Health Monitoring (ISHM) Workshop will address current use and perspectives of IVHM/ISHM as an integral part of space systems. Applications will include, but are not limited to, solid motor, liquid rocket, hypersonic, and electric propulsion.

Presentations will cover the following IVHM/ISHM topics:

- How IVHM/ISHM was used to improve safety, reliability, performance, affordability, and reusability;
- Challenges during the IVHM/ISHM process, including requirements definition, design, integration, and test activities;
- Lessons learned from achieving IVHM/ISHM optimization; and
- Technology advancement needs to enable future IVHM/ISHM capabilities.