

MS1-2: Mechanics of composites

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Mini-symposium description

This mini-symposium will cover the topics related to the mechanical response of composite materials and their structural applications. It specifically focuses on composites exposed to severe environmental conditions, such as those encountered in aircraft engines (high temperatures) or in cryogenic H₂ tanks used in the aerospace industry (very low temperatures).

For high temperature applications, various types of ceramic matrix composites (C/C, SiC/SiC, C/SiC or Oxide/Oxide) are being developed in research laboratories and in industries. There are still major challenges to be met, both in terms of damage and failure modelling of such complex materials, especially considering couplings with environmental conditions, and in terms of the mechanical characterization of properties, especially those related to the out-of-plane direction (stiffness or onset and propagation of delamination).

Composite materials can also be submitted to very low temperatures, such as those considered in cryogenic H₂ tanks for energy storage for aerospace and aeronautical applications. Laminated as well as filament winding composite materials are considered for such applications, considering both thermoset and thermoplastic matrices, with a special attention paid to leakage.

Many issues are still unexplored, due to the difficulty of performing instrumented tests at these temperatures to accurately determine the behaviour, damage and failure process. In addition, there is a current effort to design such structures in a robust manner, which requires the use of advanced physically based damage modeling.

Finally, for these two extreme temperature conditions, the fatigue lifetime has to be estimated both experimentally and numerically, with a special attention to the coupling with the environmental conditions.

The particular topics to be covered in this mini-symposium include (but are not limited to) :

- Failure criteria
- Damage modelling (continuum damage model, discrete damage model, phase-field, CZM)
- Experimental tests with extrem environmental conditions
- Multi-instrumentation of complex tests
- Thin-ply composite materials
- Thermoplastic composites modelling
- Ceramic Matrix Composites
- Damage mechanisms (matrix cracking, reinforcement-matrix debonding, delamination etc.)
- Fatigue lifetime, ageing, oxidation