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MODELING MECHANICS OF MATERIALS WITH VOIDS

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MINISYMPOSIUM

Voids are ubiquitous in all engineered and naturally occurring materials whether intentionally introduced or intrinsic to a material. They can be found at all length scales: atomic, nanometer, micrometer and macro-scale. Just as the control of materials is reaching ever-smaller dimensions, so too is our control of intentional voids. We can routinely engineer voids into materials down to the single nanometer size range and through chemistry, create sub-nanometer voids with covalent organic frameworks. As a material design criterion, these empty spaces can negatively affect the mechanical response but can also lead to a variety of interesting properties: electrical, thermal, chemical, bioactivity, etc. The designing of materials with voids simultaneously on multiple length scale is known as hierarchical porosity and is key to achieving multifunctional materials and a globally optimized system or part. Hierarchical design is becoming widely used to reduce part count, and overall system mass. In addition to the initial configuration and void content, aging and other time related phenomena can introduce additional voids or change the characteristics of the original voids in the material leading to a time-dependent mechanical response. This 4th dimension of time-dependence and hierarchical porosity are just two examples of the challenges that face mechanical modelling of materials.

This is the second Modeling Mechanics of Materials with Voids minisymposium as part of WCCM. The first was held in 2022. This minisymposium will explore the mechanical response of materials that are conceptually “built” from the ideal properties at the atomic scale to the “real” properties at macro-scale, by introducing voids/defects at the appropriate length scales along the way. Whether crystalline (metal and ceramic), network (polymer and glass) or composite materials, the mechanical response can be viewed as the contributions that voids and defects at the various length scales have on the ideal material properties. We invite submissions on modeling the effects of voids in materials at any length scale on material behavior including mechanical, thermal, chemical, biological, and electrical properties and function. While this minisymposium is listed under the focus area of Atomistic, Nano, and Micro Mechanics of Materials, papers are invited from other focus areas including, but not limited to, **Biomechanics and Mechanobiology** (500), **Materials by Design** (600), **Fracture, Damage, and Failure Mechanics** (200), **Fluid-structure Interaction, Contact and Interfaces** (1600), and **Fluid Dynamics and Transport Phenomena** (700).