MECHANICS OF NON-CONVENTIONAL MATERIALS AND STRUCTURES

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ABSTRACT

The Special Session focuses on the growing interest within the scientific community in smart materials and ultrasmall structures, driven by the challenge of modeling, designing and optimizing innovative systems and advanced devices. Notably, non-conventional materials and structures such as advanced composites, functional materials, metamaterials and small-scale systems are at the forefront of Engineering and Material Science. Furthermore, understanding Solid and Structural Mechanics at different scales is essential for addressing multiscale challenges and exploiting the full potential of miniaturized, next-generation systems. The Session thus aims to advance knowledge and promote discussions on modeling, analyzing, and designing of nano-systems, metamaterials, next-generation composites and multiscale materials. Contributions that explore mechanical behaviors influenced by size effects are particularly encouraged, along with research on unconventional responses of multiscale systems and innovative materials from theoretical, computational, and experimental perspectives. To this purpose, advanced methodologies of nonlocal and gradient mechanics will be discussed as effective tools to address above mentioned non-classical behaviors.

Key themes will include modeling and evaluation of scale effects in nanostructures, with applications to miniaturized electro-mechanical devices such as nano-sensors, nano-resonators, nano-actuators, and nano-probes. Advanced theories, such as those based on gradient elasticity and nonlocal methodologies, are essential to accurately capture size-dependent behaviors of these systems. Special attention will be given to metamaterials, composite structures and multiscale systems. Discussions will cover the design of advanced materials, assessment of effective constitutive properties of innovative composites, and emerging use of metamaterials to achieve enhanced mechanical properties. Multiscale approaches will be emphasized for their capability to bridge microscale phenomena with macroscale behaviors, enabling the advancement of unconventional materials and systems. The explored topics will also delve into the application of these innovative materials and structures across a broad spectrum of complex engineering challenges.