Paper ID: 14954
oral
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Specialised Technologies, Including Nanotechnology (8)

Author: Ms. Eleni Fiamegkou
Applied Mechanics Laboratory, Greece, elfiameg@mech.upatras.gr

Mr. Athanasios Baltopoulos
University of Patras, Greece, abaltop@mech.upatras.gr
Dr. Antonios Vavouliotis
University of Patras, Greece, vavoul@mech.upatras.gr
Prof. Vassilis Kostopoulos
University of Patras, Greece, kostopoulos@mech.upatras.gr

STATE-OF-THE-ART MODELING STRATEGIES AND CAPABILITIES FOR NANO-REINFORCED MATERIALS TARGETING SPACE APPLICATIONS

Abstract

Nano-materials have been intensively researched the past decade for various applications. Special attention has been invested in nano-reinforced composites where better functionalities are sought while multi-functionality is enabled. The space industry has intensified its interest the second half of the past decade, once the understanding and maturity of the field had grown. Future trends indicate that nano-materials will find applications in space as the technology matures and reaches higher Readiness Levels. However, bringing this novel class of materials to application in space requires integrating them into the design chain and process steps for delivering a space mission. It is therefore mandatory to incorporate such materials in traditional design and analysis processes for space (e.g. FEA). It is made clear that in order to reach the moment of launching nano-materials for a mission, we need to be able to model their performance and behavior in different levels and under different physical fields. This work focuses on providing an overview concerning the simulation and modeling capabilities for nanomaterial in a multi-scale framework. Various modeling strategies have been proposed for determining the effective and equivalent nano-material properties; Molecular Dynamics, Atomistic-Continuum techniques, Continuum techniques, Hybrid techniques (Mean field FEM and BEM). However the applicability, limitations and efficiency of these strategies for modeling of real space structures are varying. A summary of these modeling strategies along with their potential for industrial use is presented. The effectiveness of modeling different fields and properties (e.g. thermal, mechanical, electrical) is assessed at different scales. For this, throughout the work modeling predictions are cross-verified against experimentally measured values. Attention is also placed on the modeling of multiple functionalities enabled by nano-materials in couple fields (e.g. self-sensing though electrical properties, active heating though electrical fields). With this work we aims to establish the base for the current status of the modeling capabilities for design and analysis of space applications from an industrial point of view. In the above framework the current study aims at the development of an overall overview of the modeling capabilities of the nano-reinforced polymer structures towards their implementation on the design of space structures.