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Mechanics of 2D and 3D graphene ensembles and related composites under impacts and other extreme mechanical loads

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Abstract

The shielding from high-speed impacting projectiles or shock loads can be easily achieved with massive structures which, however, are not usually compatible with the requirements of real technological applications, such as flexibility and ergonomics in body armors or extreme lightweight requirements in spacecrafts. In this scenario, nanomaterials are very promising to reach unprecedented specific toughness (per unit mass). In this talk, concepts about the behavior and optimization of multilayer composite structures will be introduced and elucidated by computational modeling, with focus on graphene- and other 2D-materials-based composite armors. Furthermore, the 3D foam structuring of such 2D-materials allows to exploit the high strength and toughness observed at the nanoscale while tremendously reducing weight at the macro-level. In this perspective, the peculiar mechanics of the recently synthetized hollow aerographite networks (porosity > 99%) will be presented.

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The speaker

Stefano Signetti obtained his MSc degree *cum laude* in Civil Engineering (2013) from Politecnico di Torino, Italy. He also participated to the Alta Scuola Politecnica (ASP) program in joint with Politecnico di Milano, Italy (2011-2012, VII cycle). He obtained his PhD in Solid and Structural Mechanics (2017) from the University of Trento, Italy working at the Laboratory of Bio-Inspired and Graphene Nanomechanics (p.i. Prof. Nicola Pugno). From 2017 he joined as postdoctoral researcher the Multiscale Mechanics and Materials Modeling Lab (p.i. Prof. Seunghwa Ryu) at the Department of Mechanical Engineering, Korea Advanced Institute of Science and Technology (KAIST), Republic of Korea.

His research interests cover the theoretical and computational modelling (in particular finite element method and molecular dynamics) of the behavior of materials and structures, from 2D materials to macro-composites, under extreme conditions such as impacts, high strain and strain-rates, contact pressures to understand how to improve their energy dissipation mechanisms, also inspired by biological systems, in order to design optimized protective shields, shock absorbing materials, and crashworthy structures.

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