SEMINAR

Università degli Studi di Pavia

Computational Mechanics & Advanced Materials Group - DICAr

3D@UniPV

Virtual Modeling and Additive Manufacturing for Advanced Materials

Tapping into material architecture to go beyond the performance of conventional materials

Mechanical metamaterials can be designed to obtain extreme properties often beyond those of existing materials. The enabling aspect of their performance lies in their unique architecture, rather than in their chemical make-up. The topology of the repeating unit, the compositional periodicity, the property gradients as well as other forms of hierarchical complexity, are among the factors that can be exploited to engineer materials with adjustable and dramatically tunable properties. Some examples include materials that can expand and collapse, fold and transform in a variety of shapes, or conversely architectures that do not dilate or shrink under large temperature swings.

In this seminar, I will focus on materials engineered in my group with both soft (elastomers) and hard mesoscale architecture (metals), exhibiting shape transforming and multifunctional properties. From the first set, I will illustrate stretchy metamaterials programmed to concurrently achieve bistability and auxeticity, i.e. perforated monolithic patterns that can grow when pulled and remain stretched when the tension is removed. These materials have a large range of applications from deployable structures, flexible electronics, medical stents and resizable screens. From the second set, i.e. hard materials, I will present ultralightweight bi-material architectures with tunable coefficient of thermal expansion ranging from negative to positive including zero, thereby being of interest for satellite antennas, space optical systems, as well as precision instruments. Finally, I will touch upon our work on graded porous metals and show how their 3D architecture can be tuned in bone replacement implants, such as hip, to reduce bone loss following total hip arthroplasty.

Bistable auxetics

Bi-material building block with negative thermal expansion

Optimal lattice gradients in a hip replacement implant

Prof. Damiano Pasini

Department of Mechanical Engineering

McGill University, Montreal, Canada

June 30th, 12:00pm

DICAr MS1 Meeting Room

Via Ferrata, 3 – Pavia