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DIPARTIMENTO DI
SCIENZE E
TECNOLOGIE
AEROSPAZIALI

Architected Metamaterials for Aerospace and Medicine

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Mechanical metamaterials can be designed to obtain extreme properties often beyond those of conventional 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; others have periodic patterns that enable control over light or the mode of the mesoscopic deformation.

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 of 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.

Sito Web DAER: http://www.aero.polimi.it

June, the 29th, 2016 at 10:30
Sala Consiglio, 2nd Floor, Building B12, Campus Bovisa
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