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PROCEEDINGS

Mechanically Programmable Meta-Crystals

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ABSTRACT

Novel properties of meta-materials can be achieved thanks to precisely engineering sophisticated architecture of physical structures (i.e. meta-structuring). However, relying only on the meta-structuring limits possibilities in unlocking new properties, and severely affecting the performance and programmability of meta-materials. In contrast, the metallurgical approach focuses on engineering the natural crystals' intrinsic microstructure, allowing us to develop metallic alloys with excellent properties and performance beyond what can be obtained by the chemical composition. Recent advances in additive manufacturing (publicly known as 3D printing) enable a precisely metallurgical microstructuring of crystals such as chemical composition, crystal phases and crystallographic orientations to specific locations. In this talk, I will present unique ways to fuse the meta-structuring, metallurgical microstructuring and additive manufacturing together to create mechanical meta-materials that not only are lightweight, but also be high strength and programmable. In particular, we create meta-structures that mimic key crystalline microstructure, effectively creating self-similar crystal structures: natural crystals within artificial crystals (i.e. meta-crystals). High strength and programmability (including writing desirable information such as barcodes and shape-morphing) of meta-crystals can be achieved thanks to engineering both the crystal-like meta-structuring and metallurgical microstructuring [1-3].

KEYWORDS

Mechanical meta-materials; meta-structuring; metallurgy; meta-crystals

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