Imperial College London

3D printing with polygrain lattices

Technology overview

The development of 3D printing allows complex lattice structures to be built up layer-by-layer from a computer-aided design (CAD) model. However, typical lattice structures of a material exhibit significantly lower strength than that of a solid part of identical external dimensions made of the same material. Researchers at Imperial College have developed methods of designing and manufacturing lightweight, tough and damage-tolerant lattice structures of metallic alloys.

The basis of this method lies on the unique tailoring of the end material properties by controlling lattice architectures, similar to the control crystal microstructures offer. Complex meso-scale lattice structures in poly-grains of metals can be designed and directly manufactured by 3D printing, marrying the advantages of 3D printing with metallurgy. Such engineered lattices provide strengthening and stability of the metallic alloy product while maintaining low density compared to their solid counterparts. In addition, by controlling the orientation and type of lattice architecture, compliant structures with desirable anisotropy can be manufactured. 3D-printed polygrain lattices exhibit wide applicability in aerospace, automotive, defence, medical device and civil engineering sectors.

Intellectual Property

Lattice structures: International application number PCT/GB2018/052117

Benefits

- Designed architectures offer architected products with tailored properties that are inaccessible to conventional solids
  - High strength and highly controlled plastic deformation by utilising metal hardening mechanisms
  - High energy-absorbing lattices that are tolerant to damage and cracks as lattice boundaries, particles and phases can stop shear bands
  - Great control in the load transfer or in directing the damage
  - Lightweight
  - Anisotropy is easily achieved
- This method offers high level of scalability
- Applicability to various materials, not limited to metallic alloys

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