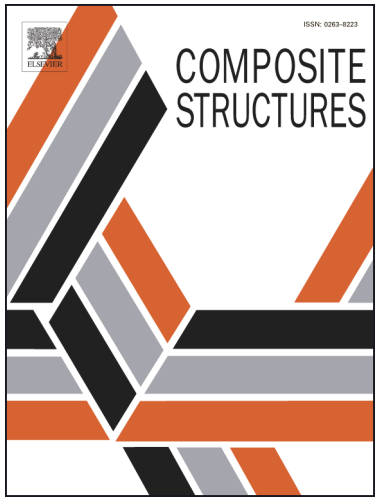

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PII: S0263-8223(16)32315-7
DOI: http://dx.doi.org/10.1016/j.compstruct.2017.05.026
Reference: COST 8535

To appear in: *Composite Structures*

Received Date: 26 October 2016
Revised Date: 26 March 2017
Accepted Date: 11 May 2017

Please cite this article as: Al-Ketan, O., Adel Assad, M., Abu Al-Rub, R.K., Mechanical Properties of Periodic Interpenetrating Phase Composites with Novel Architected Microstructures, *Composite Structures* (2017), doi: http://dx.doi.org/10.1016/j.compstruct.2017.05.026

Mechanical Properties of Periodic Interpenetrating Phase Composites with Novel Architected Microstructures

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Abstract

In this work, we investigate the mechanical properties of novel types of 3D printed interpenetrating phase composites (IPCs) with periodic architectures. IPCs are composites with co-continuous phases that interpenetrate each other in such a way that if one of the phases is removed the remaining phase will form a self-supporting cellular structure. The topology of the architected phase is based on the mathematically-known triply periodic minimal surfaces (TPMS) that minimize the effects of stress concentrations and provide better reinforcement. Here, computer added design (CAD) is employed to design the TPMS-based IPCs, then 3D printing technique was used to fabricate polymer-polymer two-phase IPCs using Polyjet 3D printing technology. The mechanical behavior of these printed IPCs is investigated under uniaxial compression. Results show that while the hard phase endures a larger fraction of the load, the softer phase confine cracks and prevent catastrophic failure. The IPCs follow a bending-dominated deformation behavior and are potential candidates for applications were damage toleration and vibration damping is a requirement.

Keywords: Interpenetrating phase composites (IPC), triply periodic minimal surfaces (TPMS), additive manufacturing (AM), 3D printing.

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