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# 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 where 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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