# Article information:

Creating tougher interfaces via suture morphology in 3D-printed multi-material polymer composites by fused filament fabrication - ScienceDirect
<https://www.sciencedirect.com/science/article/pii/S2214860422007485?via%3Dihub>

# Article summary:

1. Researchers have developed a strategy to create tougher and stronger interfaces in multi-material polymer composites using a sutural interfacial morphology between two dissimilar polymer phases PLA (hard) and TPU (soft).

2. The proposed strategy utilizes the overlap distance process parameter to create sutural interfaces with soft protrusions, which can control the protrusion amplitude and indirectly influence the interfacial defect density.

3. The interfacial toughness measurements by the double cantilever beam test reveal a linear correlation between the interfacial toughness and protrusion amplitude, resulting in up to a 16-18 fold increase in interfacial toughness compared to baseline interfaces.

# Article rating:

May be slightly imbalanced: The article presents the information in a generally reliable way, but there are minor points of consideration that could be explored further or claims that are not fully backed by appropriate evidence. Some perspectives may also be omitted, and you are encouraged to use the research topics section to explore the topic further.

# Article analysis:

The article titled "Creating tougher interfaces via suture morphology in 3D-printed multi-material polymer composites by fused filament fabrication" presents a strategy for designing and fabricating stronger and tougher interfaces in additively manufactured multi-material polymer composites. The proposed approach utilizes the overlap distance as a process parameter to create sutural interfacial morphology between two dissimilar polymer phases, PLA (hard) and TPU (soft), using the fused filament fabrication technique.

The article provides a comprehensive overview of the challenges associated with creating heterogeneous materials with strong and tough interfaces. It highlights the limitations of traditional approaches such as manipulating material chemistry or microstructure and emphasizes the need for bio-inspired strategies to achieve well-balanced combinations of mechanical properties.

The authors propose mimicking natural materials to create bio-inspired interfaces that provide enhanced interfacial toughness. They focus on sutural interfaces, which are unique structural architectures observed in a wide range of biological structures. The article discusses the mechanical and fracture behaviors of sutural interfaces, which have been broadly studied by numerous researchers.

The proposed strategy is simple yet effective, utilizing one of the common AM process parameters to modify the interfacial morphology between PLA and TPU layers. The authors demonstrate that controlling the overlap distance can result in sutural morphology without altering the interface geometry geometrically. The microscopic inspections of the interface suggest that this approach can control protrusion amplitude, which indirectly influences interfacial defect density.

The interfacial toughness measurements by double cantilever beam test reveal a linear correlation between interfacial toughness and protrusion amplitude. The proposed interfacial architecture can result in up to a 16-18 fold increase in interfacial toughness compared to baseline interface. Three distinct toughening mechanisms associated with fracture of proposed interfaces are identified: geometric toughening associated with interface roughness, enhancement of intrinsic interfacial toughness due to reduced interfacial defect density between PLA and TPU, and additional plastic energy dissipation within TPU layer.

While the article provides valuable insights into creating stronger and tougher interfaces in additively manufactured multi-material polymer composites, it has some potential biases that need consideration. Firstly, it focuses only on FFF-based AM technology while ignoring other commercially available AM technologies such as material jetting (MJ). Secondly, it does not explore counterarguments against using bio-inspired strategies for creating stronger and tougher interfaces.

Moreover, while discussing previous studies on improving interfacial adhesion in multi-material polymer composites, it fails to mention any possible risks associated with these approaches. Additionally, it does not present both sides equally when comparing FFF with MJ technology for producing multi-material composites.

In conclusion, despite some potential biases and missing points of consideration, this article provides valuable insights into creating stronger and tougher interfaces in additively manufactured multi-material polymer composites using bio-inspired strategies such as sutural morphology. It highlights the importance of tailoring interface morphology morphologically or chemically to achieve strong and tough interfaces while providing guidelines for producing multi-material polymer composites via additive manufacturing.

# Topics for further research:

* Material jetting technology for multi-material polymer composites
* Risks associated with traditional approaches to improving interfacial adhesion
* Alternative bio-inspired strategies for creating stronger and tougher interfaces
* Interfacial defect density in multi-material polymer composites
* Plastic energy dissipation in TPU layers during fracture
* Comparison of FFF and MJ technology for producing multi-material composites

# Report location:

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