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Investigation of the Effect of Processing Parameters on 3D Printed Structures

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Abstract - The Fused Deposition Modelling, which is one of the main additive manufacturing technologies, is widely used in many fields with multiple materials. Additive manufacturing shows a rapid development over the last decade and hence FDM printing machines have been improved remarkablely. In this work, the effects of several set parameters on 3D printed samples' mechanical properties and their printing quality were explored. It seems that the fill density affects samples' mechanical properties significantly and the variation of maximum load stress and the Young's modulus changed linearly with increased density. Moreover, the fill pattern affects fibre's structure and determines the products' structural properties. The mechanical properties of samples and the printing time were also affected significantly with different layer thicknesses. Samples with different fill patterns showed highly varying properties; e.g. samples with linear fill pattern showed the best tensile properties where samples with "diamond" fill pattern can have a large deformation during tests. Furthermore, the effects of different materials (e.g. PLA, ABS, carbon fibre reinforced PLA/ABS) on the properties 3D printed structures were also observed and the results showed that the samples with both carbon reinforced PLA and ABS are better in tensile properties than pure PLA and ABS. However, they were found to be more brittle in nature. Moreover, the smaples printed from carbon fibre reinforced materials showed a 45-55% increase in tensile properties and a 40-55% increase in Young's modulus comapted to pure PLA and ABS.

Key words: Additive Manufacturing, Thermoplastic Materials, Carbon Fibre, Fused Deposition Modelling, Fill Density, Mechanical and Structural Properties.

Figures:

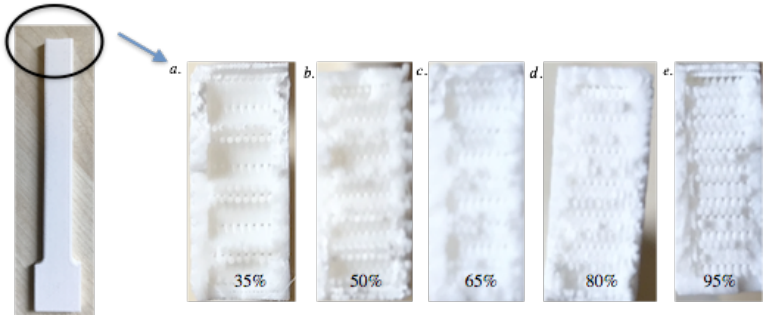


Fig. 1: Fracture surface of samples: fill density (a).35%, (b).50%, (c).65%, (d).80%, (e).95%

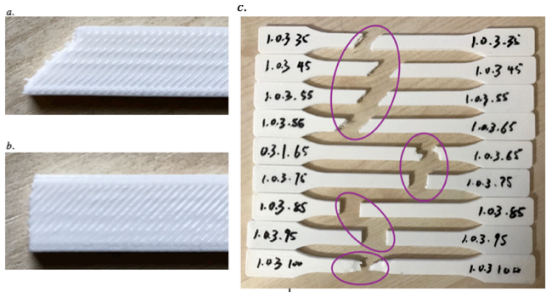


Fig. 2: Changes to the fracture plane with fill density

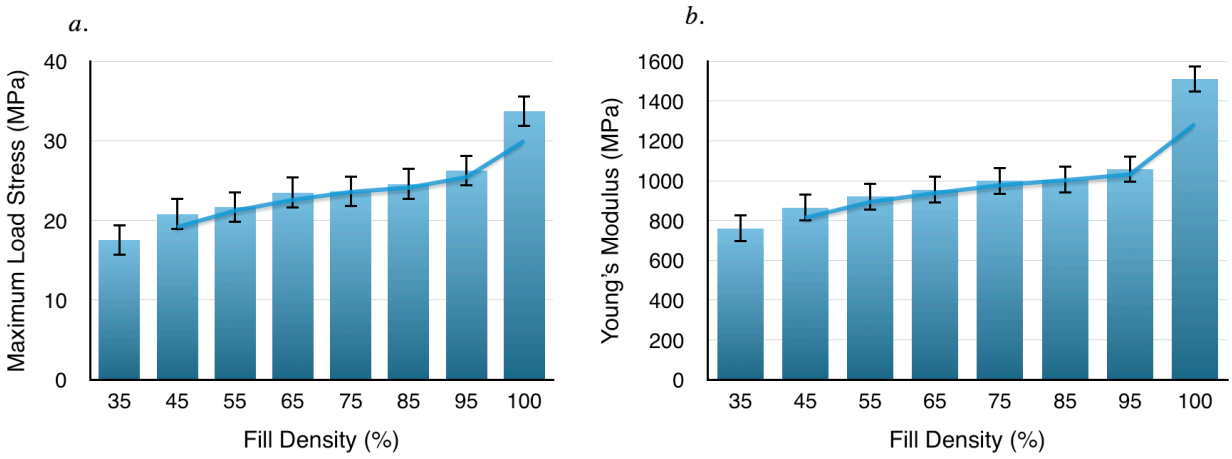


Fig. 3: The variation of maximum load stress and the Young's modulus with fill density

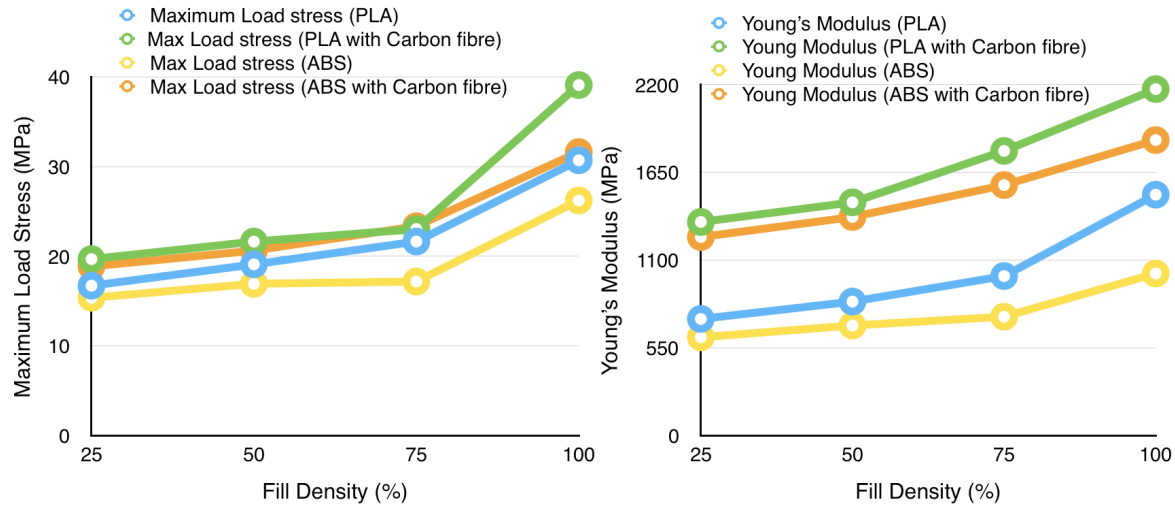


Fig. 4: Maximum load stress and Young's modulus of carbon reinforced polymer and pure PLA and ABS

Biography

Chao Zhu graduated with his Bachelor's degree from Northwestern Polytechnical University. And he will get a Meng degree from The University of Manchester next year.

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