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Investigation on the effect of processing parameters on 3D printed structures

Chao Zhu, Chamil Akeykoon and **Anura Fernando**
University of Manchester, UK

The Fused Deposition Modelling (FDM), 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 remarkably. 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 fiber'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 (Poly Lactic Acid), ABS (Acylonitrile Butadiene Styrene), 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 samples printed from carbon fibre reinforced materials showed a 45-55% increase in tensile properties and a 40-55% increase in Young's modulus compared to pure PLA and ABS.

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

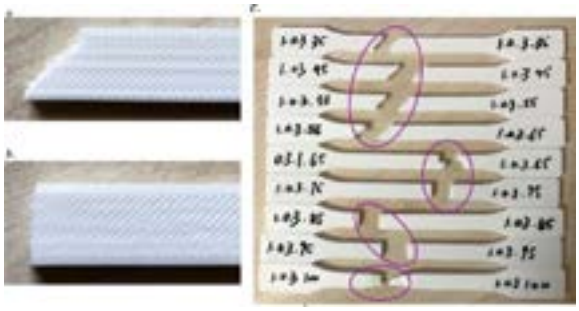

Figure 2: *Changes to the fracture plane with fill density.*

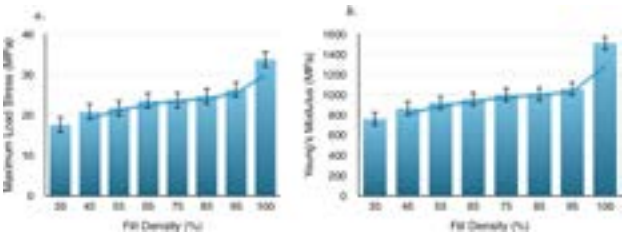

Figure 3: *The variation of maximum load stress and the Young's modulus with fill density.*

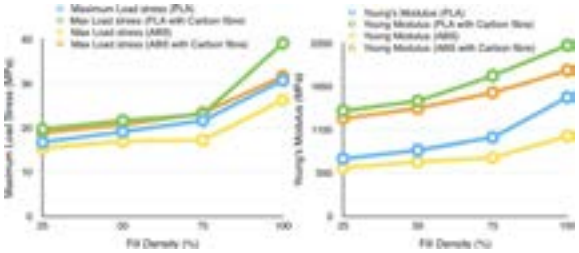

Figure 4: *Maximum load stress and Young's modulus of carbon reinforced polymer and pure PLA and ABS.*

Biography

Chao Zhu graduated with a Bachelor's Degree from Northwestern Polytechnical University, Xian, People's Republic of China. He will get a M Eng Degree from The University of Manchester next year. His interest lies in manufacturing especially in 3D Printing Future Technology.

chao.zhu-3@student.manchester.ac.uk