Investigation of Ceramic Component Mechanical Properties Fabricated with Fused Deposition Modeling Process

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Abstract
Fused Deposition Modelling (FDM) has become a revolutionary Additive Manufacturing technique in recent times due to its applications with polymeric composite materials. More intensive effort is needed to investigate the mechanical characteristics of various types of material in order to improve the engineering applications of FDM. The mechanical characteristics of ceramic components can open up a new application for the FDM process, enhancing its capabilities. However, there are certain challenges of ceramic parts fabrication in the FDM process such as fractures, porosity, warping, low accuracy, rough surface finish, shrinkage, densification, etc. In addition, there are still a lot of issues with specific material qualities and printing methods that need to be resolved. This study is conducted to address the challenges. For those purposes, samples have been produced by printing Zirconium silicate ($ZrSiO_4$ 60%, PLA 40%) in the FDM process. Following debinding and sintering, the products will undergo the Charpy test and the Knoop test to determine their impact and hardness, respectively. Layer height, extrusion temperature, nozzle diameter, number of shells, and shell width are just a few of the processing parameters that will be measured and evaluated. The study will be able to investigate the causes of finer microstructure, minor surface cracks, ultimate tensile strength, and higher yield strength. Finally, the study will undergo optimization with the mechanical property of the ceramic printed product in FDM. Practitioners can get insights into ceramic fabrication in the FDM process with optimized mechanical properties for future industrial applications.

Keywords
3D printing, Impact, process parameters, Zirconium silicate, optimization

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