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Editorial

Recent Trends on the Mechanical Properties of Additive Manufacturing

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Additive Manufacturing (AM), also known as "three-dimensional printing", has experienced significant advancements in recent years, including improvements in the mechanical properties of printed objects. Several trends have emerged in the field of additive manufacturing that have contributed to enhancing the mechanical performance of printed parts.

This Special Issue aims to gather papers investigating AM's improvements in mechanical properties, focusing on metals, ceramics, and polymers that use Fused Filament Fabrication (FFF) and vat photopolymerization.

Researchers have focused on developing new materials tailored for additive manufacturing processes. These materials possess improved mechanical properties, such as higher strength, toughness, and stiffness. On the other hand, reinforcing complex curved surfaces with manufacturing (AM) techniques presents unique challenges. Concerning the AM materials, the study by [1] analyzes the mechanical properties in flexural specimens of three-dimensionally printed continuous carbon composite specimens. Furthermore, several novel procedures have been developed to address the abovementioned challenges and enable effective carbon fiber reinforcement. The commonly employed procedures are design optimization or printing process selection. Recently, Ref. [2] proposed a novel procedure, including six algorithms for planning paths of reinforcement patches on complex and curved surfaces, obtaining promising capabilities for planning layers' paths when constructing a volume body.

An interesting AM application currently studied is to produce intricate and accurate patterns used in investment casting processes. After three-dimensional printing, the wax pattern undergoes various post-processing steps to improve its surface finish and dimensional accuracy. These steps may include removing support structures, sanding or polishing the surface, and ensuring proper dimensional accuracy through measurement and adjustment. Ref. [3] proposed a post-processing procedure, using a white spirit as a surface smoothing agent to improve surface roughness.

Another recent topic is hybrid Wire Arc Additive Manufacturing (WAAM) with milling subtractive processes, which combines additive manufacturing and subtractive machining techniques. The specific properties of hybrid WAAM–subtractive manufactured aluminum and magnesium alloys can vary depending on various factors, such as density, strength, ductility, corrosion resistance, thermal conductivity, and machinability (among others). Ref. [4] analyzed the difference in the properties of the aluminum and magnesium alloys fabricated by HWMM.

Material-extrusion three-dimensional printing, mainly using polyetheretherketone (PEEK), has gained attention for point-of-care applications due to its excellent mechanical properties and biocompatibility. Various printing parameters can influence the mechanical

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performance of material-extrusion three-dimensionally printed PEEK specimens. Ref. [5] investigated the effects of printing parameters, such as orientation and printing position on mechanical properties.

Parameter election has a noticeable effect on the surface quality and mechanical properties, not only in material extrusion technology, but also in selective laser melting [6] In addition, other variables during the printing process can affect the quality of the parts, modifying the accuracy, porosity, and mechanical properties [7].

Although submissions for this Special Issue have been closed, the research in the field of mechanical properties of additively manufactured parts continues to face challenges, such as multi-material, new ceramics materials, and technologies.

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