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Method and System to Introduce In-Process Local Thermal Modifications to Fused Filament Fabrication 3D Printing for Approved Surface Finish and Dimensional Tolerance

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Background

Additive manufacturing, also known as 3D printing, is a fabrication process to build 3D objects layer by layer based on computer aided design (CAD) models, or digital 3D models. Current filament or wire feedstock-based technologies, including the fused filament fabrication (FFF), are desirable for printing thermal plastic materials due to their capability, process flexibility, and cost-effectiveness. FFF does not require hard tooling part production with complex geometries, as compared to traditional polymer or composite production methods such as injection molding and blow molding. However, the mechanical properties, surface finish, and dimensional tolerance of FFF are limited by the layer-by-layer fabrication process.

Most current methods to improve the surface finish of FFF printed objects focus on optimizing print parameter to improve the geometrical accuracy and the surface finish. However, all current methods either fail to fully solve the problem, or require a post-processing method that significantly increases the expense of the process.

Invention Description

Researchers at Arizona State University have developed a method and system to use focused radiation in the visible or near-to-mid infrared wavelength range for localized spot heating during a filament or wire feedstock-based 3D printing of polymer or composite materials. This in-process orbiting laser-assisted surface healing method enhances surface reflow, and significantly improves surface finish in the printed region. The surface finish of the printed region is drastically improved for both flat and curved surfaces with no significant effect on mechanical strength.

The surface finish is improved by enhancing surface reflow to fill gaps between layers and uneven features created by extrusion. The surface healing process is designed to take place during printing and is capable of improving the surface finish even for curved surfaces.

Potential Applications

- Extrusion-based 3D printers
- After-market kits for 3D printer upgrades

Benefits & Advantages

- Faster processing time
- Lower cost (no post-processing methods required)
- Provides better quality as compared with conventional methods
- Reduces surface roughness of FFF 3D printed parts
- Can be used for large scale applications

Related Patent: US10,710,353 “Systems and Methods for Laser Preheating in Connection with Fused Deposition Modeling”