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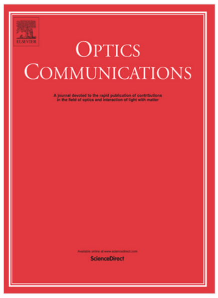

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Enhancement of Surface Reflectivity of Fused Deposition Modeling Parts by Post-processing

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Abstract

Fused deposition modeling (FDM) parts were enhanced by post-processing to improve surface roughness. After reforming with loading and heating applied, the surface can reflect light. Hence, FDM parts with reflective surfaces fabricated from the regular FDM process can be used as optical elements. In printed specimen tests, one surface of the specimen is put on a glass sheet, and both are heated and pressured together to reform the surface of FDM parts. A fabrication process performed by combining surface improved FDM parts to duplicate a smaller size optical element is also demonstrated. After testing several materials, almost every printed specimen is affected by post-processing, and the optical reflectivity of the FDM parts is increased. However, shrinkage causes a reduced height, and the shape of the FDM parts is deformed dramatically if in higher temperature heating condition. The proposed post-processing method improves the surface of FDM parts, and a fabrication process combining this method and investment casting to duplicate an optical element was established.

Keywords: 3D printing; fused deposition modeling; material testing; surface roughness.

1. Introduction

Of all rapid prototyping technologies, three-dimensional printing technology has advanced most rapidly in recent decades. Rapid prototyping, also known as additive manufacturing or layered manufacturing, refers the process of building objects from computer-aided design (CAD) model data through material deposition layer by layer. Various three-dimensional printing methods have been developed, such as fused deposition modeling (FDM), laminated object manufacturing (LOM), stereolithography (SLA), selective laser sintering (SLS), and selective laser melting (SLM). Many studies have already compared or surveyed these methods [1-7]. In the current state of 3D printing, it is sufficient to print small high-resolution objects or micro-scale structures [8-9] that can be used for micro-devices such as printed microfluidic optical devices [10-11] and optical phantom [12] for biomedical applications or printed optical elements for sensing, display, and illumination [13-14]. Especially in optical field, customized optical elements or devices are usually expensive and time-consuming. However, with the 3D printing technology, a high cost-performance product or research can be created. For examples, spherical lens [15], diffractive lenses [16-22], zone plate [23], waveguide [24-26], fiber [27], and tunable terahertz applications [28] were successfully printed for terahertz radiation ranges. Other applications such as microwave lenses [29-30], regular lenses for eyeglasses [31], mirror [32], antireflective coating [33-34], and other printed optics [36-37] were also fabricated using 3D printing technology.