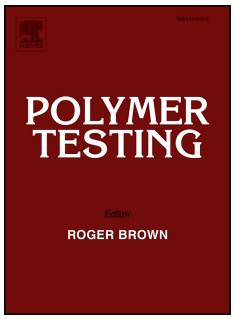

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Optical Sensor-Based Measurements of Thermal Expansion Coefficient in Additive Manufacturing

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Abstract

The applicability of fiber optic sensors for measuring the coefficient of thermal expansion (CTE) of thermoplastic parts fabricated through Additive Manufacturing is investigated. Prismatic specimens were fabricated via the Fused Deposition Modeling (FDM) technique and Fiber Bragg Grating (FBG) sensors were embedded within the structures during the building process. The specimens were manufactured featuring various raster orientations and were then subjected to thermal cycling. The wavelength measurements recorded from the optical sensors were employed for the calculation of the thermally induced strains in the specimens as a function of temperature. The obtained curves presented a linear behavior until the T_g, where the internal phase change is manifested with a peak and a subsequent decline of the curve. The CTE was calculated and the effect of raster orientation on the thermal expansion behavior was identified.

Keywords

Additive Manufacturing; Fused Deposition Modeling; Fiber Bragg Sensor; Coefficient of Thermal Expansion; Glass Transition Temperature

1. Introduction

Additive Manufacturing (AM) technology represents a family of distinct fabrication techniques which all share a common characteristic: the physical object is fabricated through the sequential deposition of layers on the basis of a three-dimensional computer-aided designed (3D CAD) model. Among the available AM

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