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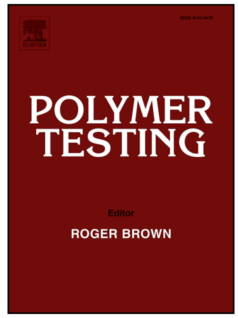

Fracture mechanics of laser sintered cracked polyamide for new a method to induce cracks by additive manufacturing

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Material Properties

Fracture mechanics of laser sintered cracked polyamide for new a method to induce cracks by additive manufacturing

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Abstract
This paper presents an experimental investigation on specimens manufactured by Selective Laser Sintering (SLS), with the purposes of giving designers advice when designing 3D printed parts, and laying the basis for a step forward in the field of fracture mechanics of 3D complex parts.
The aim is to investigate the effect of building direction in Polyamide (PA) 3D printed samples and to assess whether a crack can be initiated directly from the sintering process for fracture mechanics study purposes.
Six different configurations of Mode I Compact Tension (CT) specimens were manufactured and tested; the experiments were monitored by Digital Image Correlation (DIC) and fractured surfaces were analyzed using microscopy.
Results showed that samples with better mechanical performance are those in which all the layers contain a portion of the crack. On the other hand, those with layers parallel to the crack plan offer a preferential pathway for the crack to propagate. DIC and fractography investigations showed that, under certain conditions, small-radius geometries, or too-close surfaces may bond together depending on printer resolution. Experiments also showed that SLS is capable of printing specimens with internal cracks that can be used to study fracture mechanics of complex parts or parts with internal cracks.

Keywords
Selective Laser Sintering, Fracture Mechanics, Digital Control Imaging, Additive Manufacturing

1 Introduction

Selective Laser Sintering (SLS) is one of the most popular additive manufacturing (AM) techniques: it uses a laser beam to sinter powder to build objects bottom-up, layer-by-layer [1]. SLS can be applied to a large range of materials such as metals, ceramic, wax or polymers, and has nowadays spread to a large range of products, from aerospace to sports-car components [2].
SLS presents several advantages if compared with traditional manufacturing techniques for plastics, especially for low or medium size batches, mainly due to the combination of design freedom given by the AM technique and the large range of materials that can be processed [3].
Homogeneity and isotropy of the SLS products are big issues, especially when designing structural components. Chooke at al. [4] performed a rigorous analysis of