Polcom 2020 Abstract

The fracture mechanisms of additively manufactured short and continuous fibre reinforced nylon composites

Yingwei Hou, Janos Plocher, Ajit Panesar*
Imperial College London, Department of Aeronautics, South Kensington Campus, Exhibition Road, SW7 2AZ London, UK, Email: a.panesar@imperial.ac.uk

Keywords. Additive manufacturing, fibre reinforced composites, fracture mechanism

Abstract.
Additive manufacturing (AM) attracts increasing interests due to its advantage of manufacturing customized parts with reduced material waste and the redundancy of mould. Recent development of AM allows for the printing of fibre reinforced polymer composites for engineering applications. This study focuses on investigating the fracture mechanisms of 3D printed short and continuous fibre reinforced nylon 6 composites. The ultimate failure behavior of samples undergoing different loading conditions, i.e., tensile and three-point bending forces were analyzed and the fracture surfaces were observed. Different fracture mechanisms were found between the 3D printed nylon and fibre reinforced nylon (FRN) composites. The printed nylon showed ductile fracture behavior, while the printed FRN exhibited more brittle failure. Furthermore, the printed samples showed distinctive layer-by-layer structure and the structure was no longer observed after ultimate failure as cracks propagated along the interfaces between contiguous printed layers when the specimen was withstanding the force. Zigzag fracture pattern was found in the FRN specimens subject to bending load indicating the delamination mechanism resulted from the weak interlayer bonding. The findings could be helpful for engineers to design structural applications using 3D printed parts as well as the development of AM technology in industries.