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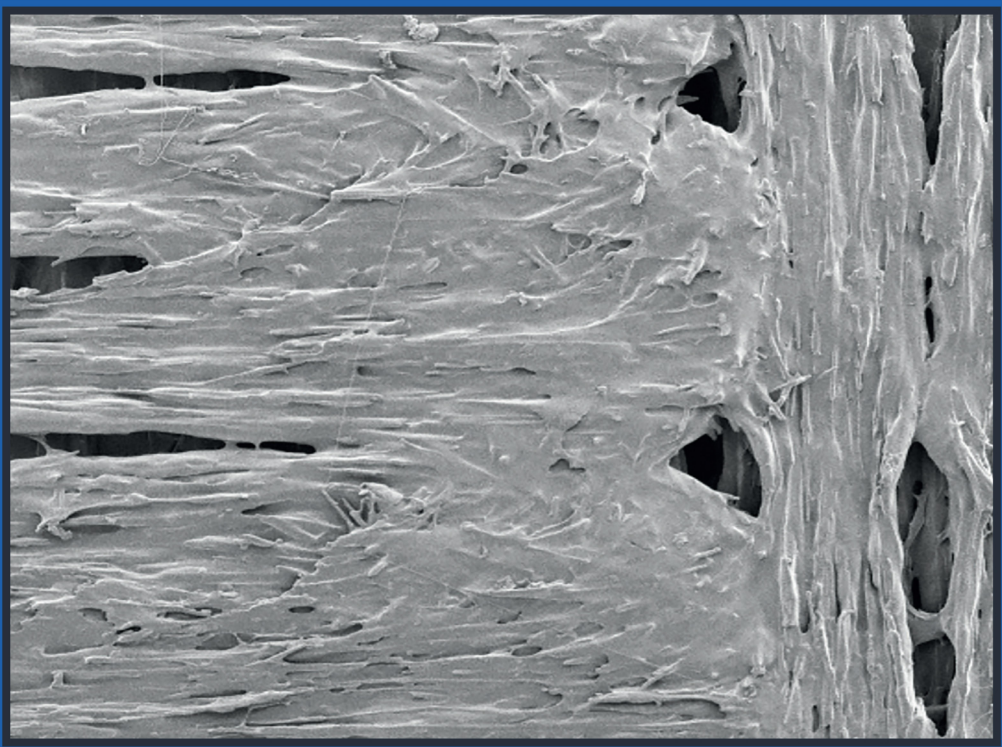

STRUCTURE AND PROPERTIES OF ADDITIVE MANUFACTURED POLYMER COMPONENTS

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Direct ink writing of polymers and their composites, and related applications

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1 Introduction

Direct ink writing (DIW) was proposed as a novel additive manufacturing technology enabling rapid fabrication of geometrically complicated net-shape structures with high resolution and controllability [1,2]. Its controllability includes excellent control of geometry architecture and dimension, and effectively there is almost no waste of value materials [3]. DIW is one of the printing techniques that are based on continuous ink filaments extrusion and computer program controlled deposition, allowing the rapid fabrication of three-dimensional (3D) structures through a layer-by-layer constructing sequence without the requirement of expensive accessories such as tooling and masks [2,4].

Fig. 1 schematically illustrates the simple process diagram of DIW printing technique through which a 3D microstructure is built by a computer-controlled program that moves an extrusion equipment along the x, y, and z axes. The first layer of a 3D structure is fabricated on a substrate by the deposition of the continuous ink material. The position of the deposition nozzle is then incremented in the z-direction for the fabrication of the following layers in a continuous manner. A predesigned structure that would be accurately fabricated, and its printing resolution depends on the rheological properties of the ink material and the precision of the printing apparatus [2,5]. For instance, an excessive high viscoelasticity of materials and nanofiller clusters may cause processing problems, such as nozzle blockage [6,7]. For all extrusion-based 3D printing techniques, an

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