Development and Characterization of Gear Shape Porous Scaffolds Using 3D Printing Technology

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Abstract: Continuous porous structures of biodegradable polylactic acid (PLA) were fabricated using a rapid prototyping machine with the three dimensional fused deposition modeling (FDM) technique. Effects of two different circle packing methods, the square (SQ) and the hexagonal (HEX) packings, and different pore diameters on the compressive mechanical properties were examined. The compression test results showed that SQ1 and HEX1 with 1 mm pore diameter had the largest compressive properties, suggesting that the microstructures were well constructed compared to the other specimens. Although SQ0.7 and HEX0.7 exhibited the lowest porosities, the modulus values were lowest, indicating that the microvoids degraded the stiffness of the structures. Scanning electron microscopy of the damaged regions suggested that microcracks were generated along the interlayers or within the layers due to bending deformation and the final fracture were initiated with these microcracking mechanism. It is thus concluded that the fabrication process must be improved so that the microcrack formation is minimized. Finite element analysis was used as an evaluation tools by comparing the experimental compressive modulus and a good agreement was exhibited correspondingly.

Key words: Compressive property, microcracking, polylactic acid, scaffold, 3D printer.