

MICROSTRUCTURE CHARACTERISTICS AND MECHANICAL PROPERTIES OF MAGNETIC FREEZE CAST SCAFFOLDS

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Magnetic freeze casting is a physical process for fabrication of anisotropic porous scaffolds of ceramics, metals and polymers. In this process external magnetic field is applied to align microstructure in transverse direction. Depending on magnetic susceptibility of particles, magnetic field strength, temperature of slurry and particle size two different microstructure patterns are observed; lamellar wall alignment versus mineral bridge alignment. Lamellar wall or mineral bridge characteristics determines mechanical properties of the scaffolds. As each processing conditions in magnetic freeze casting can change several characteristics simultaneously therefore to have control over microstructure and change each characteristic separately, scaffolds mimicking patterns in magnetic freeze casting are 3D printed and tested under compression test. This determines relationship between microstructure and mechanical properties. Scaffolds made by freeze casting have significant strength in solidification direction but they are weak in transverse direction. Applying external magnetic field enhances strength in transverse direction but a small drop in strength is observed in solidification direction. Finally, to compare scaffolds based on multiple properties, permuted radar chart method is developed and multi-functionality of scaffolds are compared.

MONDAY, SEPTEMBER 24 3:00 PM

EIB 132