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# Synergistic structures from magnetic freeze casting with surface magnetized alumina particles and platelets

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## ABSTRACT

Magnetic freeze casting utilizes the freezing of water, a low magnetic field and surface magnetized materials to make multi-axis strengthened porous scaffolds. A much greater magnetic moment was measured for larger magnetized alumina platelets compared with smaller particles, which indicated that more platelet aggregation occurred within slurries. This led to a more lamellar wall alignment along the magnetic field direction during magnetic freeze casting at 75 mT. Slurries with varying ratios of magnetized particles to platelets (0:1, 1:3, 1:1, 3:1, 7:1, 1:0) produced porous scaffolds with different structural features and degrees of lamellar wall alignment. The greatest mechanical enhancement in the magnetic field direction was identified in the synergistic condition with the highest particle to platelet ratio (7:1). Magnetic freeze casting with varying ratios of magnetized anisotropic and isotropic alumina provided insights about how heterogeneous morphologies aggregate within lamellar walls that impact mechanical properties. Fabrication of strengthened scaffolds with multi-axis aligned porosity was achieved without introducing different solid materials, freezing agents or additives. Resemblance of 7:1 particle to platelet scaffold microstructure to wood light-frame house construction is framed in the context of assembly inspiration being derived from both natural and synthetic sources.

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