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Additive manufacturing and mechanical properties evolution of biomedical Co-Cr-Mo alloys by using EBM method

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The microstructures and mechanical properties of Co-29Cr-6Mo alloy with C and N additions, produced by additive manufacturing using electron beam melting (EBM) method, were studied using X-ray diffraction, electron back scatter diffraction, transmission electron microscope, Vickers hardness tests, and tensile tests, focusing on the influences on the build direction and the various heat treatments after build. It is found that the microstructures for the as built specimens were changed from columnar to equiaxed grain structure with average grain size of approximately 10-20μm due to the heat treatment employing the reverse transformation from a lamellar (hcp + Cr_2N) phase to an fcc. Our results will contribute to the development of biomedical Ni-free Co–Cr–Mo–N-C alloys, produced by EBM method, with refined grain size and good mechanical properties, without requiring any hot workings.

Keywords: Co-Cr-Mo, Additive manufacturing, Electron beam melting, X-ray diffraction, Transmission electron microscope

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3D porous ceramic scaffolds prepared by the combination of bone cement reaction and rapid prototyping system

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Clinically-favored materials for bone regeneration are mainly based on bioceramics due to their chemical similarity to the mineral phase of bone. A successful scaffold in bone regeneration should have a 3D interconnected pore structure with the proper biodegradability, biocompatibility, bioactivity, and mechanical property. The pore architecture and mechanical properties mainly dependent on the fabrication process. Bioceramics scaffolds are fabricated by polymer sponge method, freeze drying, and melt molding process in general. However, these typical processes have some shortcomings in both the structure and interconnectivity of pores and in controlling the mechanical stability. To overcome this limitation, the rapid prototyping (RP) technique have newly proposed. Researchers have suggested RP system in fabricating bioceramics scaffolds for bone tissue regeneration using selective laser sintering, powder printing with an organic binder to form green bodies prior to sintering. Meanwhile, sintering process in high temperature leads to bad cost performance, unexpected crystallization, unstable mechanical property, and low bio-functional performance. The development of RP process without high thermal treatment is especially important to enhance biofunctional performance of scaffold. The purpose of this study is development of new process to fabricate ceramic scaffold at room temperature. The structural properties of the scaffolds were analyzed by XRD, FE-SEM and TEM studies. The biological performance of the scaffolds was also evaluated by monitoring the cellular activity.

Keywords: Scaffolds, Cement reaction, Room temperature fabrication