Flash Sintering of Hydroxyapatite and Titania Composite Structures for Biomedical Applications

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Flash sintering is a novel method of materials densification which reduces the sintering time and temperature by applying a simultaneous electric and thermal field to the specimen. Hydroxyapatite, the major constituent of bone grafts and insulating material by nature, is flash sintered in this experiment in order to improve the mechanical properties for its load-bearing application. Titania is added to the material system in order to optimize the specimen with respect to electrical and mechanical properties while maintaining biocompatibility. The *in situ* Energy dispersive x-ray diffraction measurements were conducted at the 6 BM-A beamline of the Advanced Photon Source at the Argonne National Laboratory. The polychromatic x-rays that are generated by a linear accelerator are directed into the hutch via a bending magnet and are collimated through a series of slits to a precise white synchrotron radiation. In EDXRD studies, the measurements are collected at a fixed angle of $2\theta = 3°$ and in Laue geometry which results in a gauge volume with parallelepiped geometry.[15]Energy Dispersive X-ray Diffraction scans were collected every two seconds in this experiment, from which d-spacing and lattice parameters were calculated with respect to temperature. With 10 wt. % addition of titania, a hydroxyapatite composite specimen was flash sintered at 825 °C. Mechanical testing shows a Vickers Hardness of 2.204 GPa for the flash sintered hydroxyapatite/titania composite specimen, a five-fold magnitude increase compared to traditionally sintered hydroxyapatite specimen.

KEYWORDS: Flash sintering, densification, electric field, hydroxyapatite, titania, EDXRD

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