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2nd International Conference and Expo on
Ceramics & Composite Materials
July 25-26, 2016 Berlin, Germany

3D additive manufacturing of bioceramic applied to the bone reconstruction using reverse thermo-responsive hydrogel technique

Chih-Kuang Wang[1], Fu-Yuan Teng[1, 2], Li-Cheng Pan[1] and Jen-Shiou Lin[1]
[1]Kaohsiung Medical University, Taiwan
[2]Kaohsiung Armed Forces General Hospital, Taiwan

The key advantages of a 3D printed biodegradable scaffolds are custom control of shape, porosity, pore connectivity, material composition, site-specific drug/growth factor delivery, and orientation. Another limitation in 3D printed parts is that the mechanical properties of printed objects do not always resemble the repaired tissue in terms of modulus, and strength. Improvement in mechanical strength often resulted in compromise in biodegradability or biocompatibility. Clinical reported that porous biphasic bioceramics of hydroxyapatite/β-tricalcium phosphate (Hap/β-TCP) can promote osteoconduction during new bone formation in in vivo experiments. However, the brittle nature of porous bioceramic substitutes cannot match the toughness of bone, which limits the use of these materials for clinical load-bearing applications. Fortunately, our novel methods to enhance mechanical properties are mainly based on the admixture of a combustible reverse negative thermo-responsive hydrogel (poly(N-isopropylacrylamide base) that burns away during sintering in the resulting object. This method can be regarded as functioning in a manner similar to the cold isostatic press (CIP) step before the powder sintering densification process. In other words, sintering densification is expected via free volume contraction, which will increase the mechanical properties after the formation of the porous bioceramics. We will develop the curved shape bioceramic block with interpenetrating channels for bone reconstruction. The study aimed to investigate the processing chain, the dimensional accuracy and the mechanical and physical characteristics of the implants.

Biography

Chih-Kuang Wang has completed his PhD from National Cheng Kung University and Post-doctoral studies from Industrial Technology Research Institute (ITRI) in Taiwan. He is a staff member of the Department of Medicinal and Applied Chemistry and also the Investigator working in the Orthopaedic Research Center (ORC) at Kaohsiung Medical University (KMU). He has published more than 40 papers in reputed journals, 5 kinds of patent have been acquired, and 3 kinds of patent application are in process.

ckwang@kmu.edu.tw

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