UNIVERSITI TEKNOLOGI MARA

Hydroxyapatite Slip Casting Technique for Ceramic Design Application

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The research is based on research topic on synthetic bone constructive design. The research started from the need for bone reconstruction for fractured or damage bone. Studies on alternatives of synthetic bone have led to the development of bioceramic material because the material has biocompability with natural bone. The discovery of hydroxyapatite added the advantages of bioceramic as the material was found to have similar properties with natural bone. Other than that, it has the ability not only as bone graft material but also to facilitate bone growth. The application of hydroxyapatite (HA) bone graft application has some limitation as the material is brittle. Thus, it can be categorised into the load bearing and non-load bearing application. The research focussed on non-load bearing application, particularly for skull damage cases. In cranioplasty surgeries, damaged skull bone need to be repaired. There are many material proposed such as titanium mesh, burr bole button and calcium phosphate cement. However, these materials have some limitation on the aspect of cost, material handling and radius curve and the bone growth facilitation. In this research slip casting technique was proposed to address the gap as it could be manufactured with cost effective and the ability to cast intricate shape and form. The HA was successfully synthesized with 1100W microwave heat treatment and then freeze dried to obtain the powder form. The HA powder was then successfully converted into suspensions with sodium hexametaphosphate as dispersion agent. Prior to that, the HA was confirmed through x-ray diffraction (XRD) test. Thermal behaviour upon heating was investigated with thermogravimetry and differential scanning calorimetry (TG/DSC) and it was determined that 1100°C is the sintered temperature. The slip casting produced non-uniform casting form. The slip casting produced a non-uniform casting thickness for hollow casting. However, the outcome is more promising when casted in solid mould. Due to the fast drying ability, the slip is more appropriate for solid casting as it could be produced within short duration. Low shrinkage is also another advantage, as the slip could be promising for the free hassle mass production and customized design. This basic casting ability is very promising to be introduced in the cranioplasty surgery in the future.

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