UNIVERSITI TEKNOLOGI MARA

PORE CHARACTERIZATION OF POROUS PCL/HA NANO-COMPOSITE ANALYZE USING IMAGE J SOFTWARE

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ABSTRACT

Supercritical CO_2 gas foaming method has been one of the favourable method in producing polymer composite for Bone Tissue Engineering due to absent of inorganic solvent that will might cause inflammation if in contact with cell tissue. This is the method to produce PCL/HA composites which had been recognize for its biocompatibility and mechanical structure. Several parameters of process such as foaming temperature and pressure will affect the pore characteristics alongside with the HA content. In this study, the effect of temperature, pressure and HA content was investigated on the pore characteristic of the composite. The samples were fabricated at 10MPa, 20MPa and 30MPa at 40°C and 45°C with 10%, 20% and 30% HA content. The characteristic were analyzed using Software Image J. Results show that increase in temperature cause the pore size, porosity and density to increase. Increase in pressure cause the density and porosity increase but decrease in pore diameter. As HA content increases, the porosity and pore diameter decrease. Overall, this results found that temperature, pressure and HA significantly affect the pore characteristics of the samples. The size obtained are in compliance with the requirement to be used in Bone Tissue Engineering.

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CHAPTER ONE
INTRODUCTION

1.1   Research Background

The usage of reconstruction procedures in orthopaedics has resulted a rise in surgical advancement and in the bone implant development. Synthetic porous scaffolds are used to be made of polymers, metals, ceramics or composite biomaterials. These materials does not consider the properties and original structure of cells and natural tissues. Therefore, these synthetic scaffolds tend to cooperate poorly with the cells and surrounding tissue. (Wu et al., 2014) Due to that, the surgical outcomes are mostly unsatisfactory because of corrosion and wear, mechanical undesirable match and a lot of other unfavourable properties. (Wu et al., 2014)

The best scaffolds must exhibit the natural extracellular matrix (ECM) as much as possible. ECM in natural tissues supports proliferation, differentiation and cell attachment. These indicate that scaffolds shall contain a fitting biochemistry and nano/micro-scale surface topographies so that a complimentary binding sites can be achieved to regulate and control cell and tissue behaviour on full function, along with connecting to host cells. (Wu et al., 2014) Besides that, scaffolds will have to impose the macro structure that are found in natural bone. By having this feature, the growth of cells and new tissues can take place efficiently. It is also the growth factors carrier. Another important concern is the mechanical properties of scaffolds.

PCL/HA is a blend of two materials that aids in bone tissue scaffold. PCL/HA composite was found to be the most suitable materials for tissue regenerative. PCL is very bio compatibility with bone tissue and have slow degradation rate. But it has low density. The presence of HA slightly increased the density. In this study, porous PCL/HA composite was prepared at different temperature and pressure to obtain the optimum pore size of porous PCL/HA. Software Image J will be utilize to analyze the pore characterization in order to investigate the effect of temperature and pressure to the pore characterization. The structural characteristics of the scaffolds such as porosity and pore size will affect their purpose. The pore size and porosity will impact cell behavior and influences the mechanical property of the scaffold.