PROCESSING OF BIPHASIC CALCIUMPHOSPHATE/POLY-DL-LACTIDE-CO-GLYCOLIDE COMPOSITE BIOMATERIALS THROUGH COLD AND HOT PRESSING

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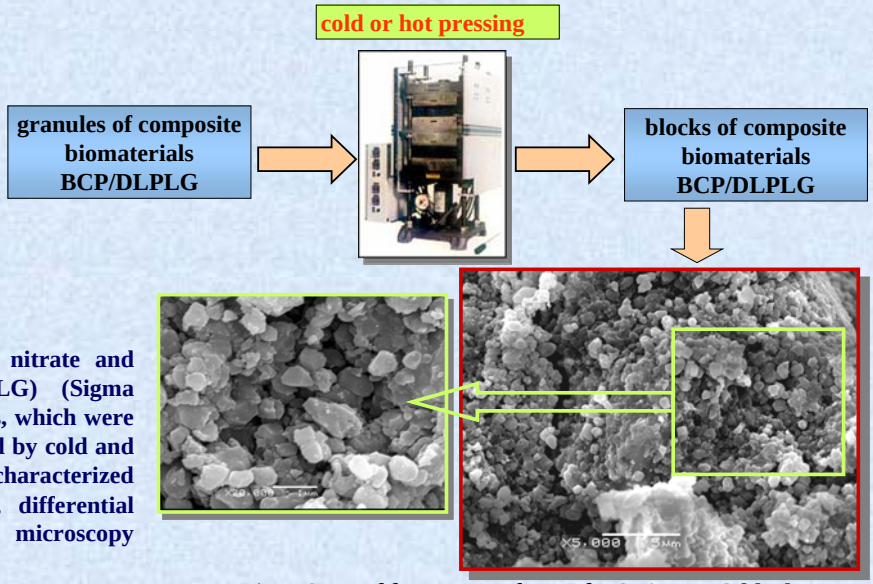
Introduction

The reconstruction of bone tissue may be done by various biomaterials. In the case where the bone tissue interruptions are present, the implant materials must have good mechanical properties [1-4].

In this paper, the possibility of designing the properties of BCP/DLPLG biocomposite blocks by cold or hot pressing has been studied. The effects of hot pressing parameters, such as temperature and pressure, on the density and compressive strength of cold or hot pressed blocks have been investigated



Materials and Methods

A calcium phosphate was produced by precipitation of calcium nitrate and ammonium phosphate[1, 2]. Poly-DL-lactide-co-glicolide (DLPLG) (Sigma Chemical Company, USA) was used as a polymer component. Blocks, which were the object of density and compressive strength testing, were produced by cold and hot pressing of granules [4]. Blocks of composite biomaterials were characterized by wide-angle X-ray structural analysis (Enraf Nonius FR590), differential scanning calorimetry (DSC-50 SHIMADZU), scanning electron microscopy (JEOL-JSM 6460LV) and IR spectroscopy (Perkin-Elmer 983G).

Fig 1. SEM of fracture surfaces of BCP/DLPLG blocks

Results and Discussion

The microstructure of fracture surfaces shown in Fig. 1 was obtained after 15 minutes of hot pressing of BCP/DLPLG at 324K and 10000 kg/cm^2. Very fine distribution of BCP particles in the DLPLG base can be seen in details of Fig. 1. Figures 2 and 3 show the values of density and compressive strength of the blocks pressed at different pressure and two temperature values: 291 K for cold and 324 K for hot pressing. Maximum value of density and compressive strength is achieved during pressing at 10000 kg/cm^2 and pressing temperature of 324 K. Figures 4, 5 and 6 show XRD, FT-IR and DSC spectra of BCP/DLPLG blocks (0) obtained after cold pressing at 1000 kg/cm^2 (1); 10000 kg/cm^2 (2); at 324K and 1000 kg/cm^2 (3); at 324K and 10000 kg/cm^2 (4). Curve 4 with peaks on 1381 cm^{-1} indicated degradation of DLPLG after hot pressing at 324K and 10000 kg/cm^2 (Fig 5).

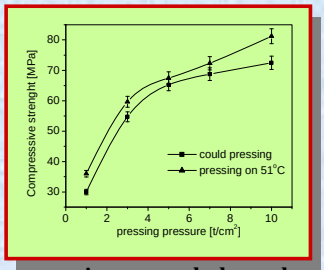


Fig 2. Compressive strength dependence on processing pressure and temperature

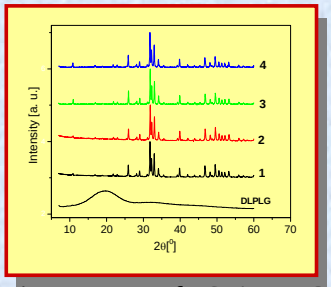


Figure 4. XRD of BCP/DLPLG blocks after cold and hot pressing

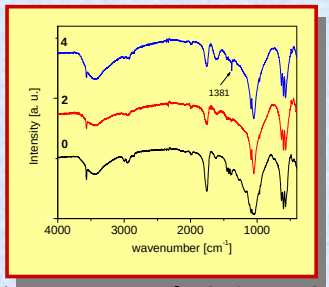


Figure 5. FT-IR of BCP/DLPLG blocks after cold and hot pressing

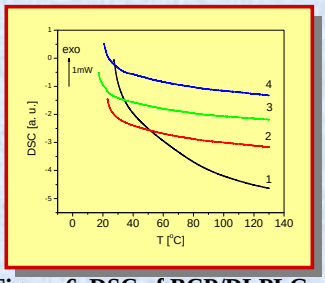


Figure 6. DSC of BCP/DLPLG blocks after cold and hot pressing

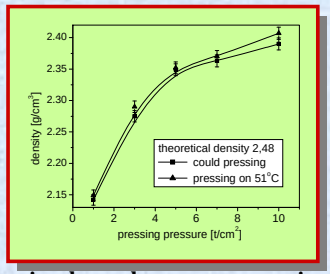


Fig 3. Density dependence on processing pressure and temperature

Conclusion

BCP/DLPLG composite biomaterial was produced in the form of blocks. The composite is suitable for application as plates in reparation of bone tissue. Blocks of 97% theoretical density and compressive strength of 82 MPa were produced by hot pressing at the temperature of polymer glass transition temperature (324K).

References:

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