Mechanical properties of hydroxyapatite hexagonal boron nitride composites

Merve Geçgin¹, Emre Alli¹, Yapıncak Göncü², Nuran Ay¹.

¹Material Science and Engineering, Anadolu University, Eskişehir, Turkey; ²BORTEK Boron Technologies and Mechatronics Inc, Eskişehir, Turkey

Introduction: Hydroxyapatite is widely used as a biomaterial because of its good biocompatible, bioactive and chemically similar to inorganic compound of human skeleton system [1][2]. Its usage is restricted in the bone and teeth implants because of its poor mechanical properties under load bearing applications. To improve the mechanical properties of HA, it is used such as making composites, different shaping techniques and under various heat treatment. Hexagonal boron nitride (hBN) is an artificial material with layered crystal structure that has biocompatible and non-cytotoxic material for orthopedic applications[3][4][5][6]. In this study, it was investigated how to affect mechanical properties of adding hBN to HA.

Material and method: Nano HA and nano hBN powder were used as a raw materials and PVA was used as a binder. Nano hBN 0, 2.5, 5.0 and 10.0 wt. % was added to HA. Raw materials and PVA were mixed in a ball mill under wet conditions using zirconia balls for 6 hours and dried at 70°C. The dried powders were ground and screened with 35 mesh screen. Composite powder were compacted in a cylindrical die by CIP at the pressure level of 100 MPa and 150 MPa at room temperature with a dwell time 45 sec and 60 sec. All samples were heat treated of 1100 ºC. The cylindrical sintered specimens were subjected to a three-point bending test by Instron machine. Each test was carried out five times. The sintered samples were characterized by XRD, FTIR and SEM.

Results and discussion: The bending strength of sintered samples under (every) each forming conditions are shown in Figure 1. The effect of forming pressure and duration time is not clear on bending strength of sintered samples. But the bending strength of sintered samples increased while increasing amount of hBN. This results were reported by Prajatelistia et al.[7] and Lahiri et al.[8]. Figure 2 and Figure 3 show SEM micrograph of fracture surface of sintered samples at 100 MPa 60 seconds. Fracture behavior of sintered samples changed while adding hBN. Nano hBN causes grain growth and enlargement of pores. FTIR results of sintered samples will be examined.

Figure 1. Bending strength of sintered samples
Conclusions: The effect of nanohBN amount on bending strength is more significant than the effect of forming conditions. NanohBN causes grain growth and enhancing the sinterability.

This research was supported by The Scientific and Technological Research Council of Turkey (TUBITAK), by National Science Foundation through Grant No. 112M590.

References:


Keywords: biomaterial, calcium phosphate, mechanical property, nanocomposite