aluminium matrix, and moreover, the heat-treatment resulted in the formation of non-crystalline Al4C3 layer between fiber and pure aluminium matrix by energy dispersive X-ray spectroscopy in the TEM. New nucleation sites of aluminium carbide crystal occurred in this layer.

**MMC-11: Evaluation of Design Strength and Residual Stress in Ceramic/Metal Joint**

S.C. HUH, W.J. PARK, S.H. PARK, Gyeongang National University,
E-mail: schuh@nongae.gsu.ac.kr

Since the ceramic has excellent qualities in light weight, abrasion resistance and heat resistance etc, compared with the metal, it has been actively examined in order to apply for the structures such as gas turbine and turbo charger etc, which require high strength and heat resistance. But it is not desirable to be used for the structural material since the ceramic is fragile, so the join with the metal with abundant toughnees has been studied. However, during the cooling process, the joint residual stress develops on the ceramic/metal joint by the difference in thermal expansion coefficient between two materials and it affects the bending strength significantly. Also, in order to use the joint material as the structural material, the study about the fatigue of thermal cycle of actual use statement is necessary. Therefore, to ensure security and improvement of the bending strength of joint material, the state of residual stress distribution to the high temperature-thermal cycle, and studied the effects of thermal cycle and state of residual stress distribution on the strength of joint material as well.

**MMC-12: Residual Stress on the Yielding Properties of SiC/Ti Plate**

F. ZHOU, Johns Hopkins University; R. HASHIMOTO, A. OGAWA, Y. SOFUE, Japan Aerospace Exploration Agency,
E-mail: fzhou@jhu.edu

Thermal residual stress (TRS) created in metal matrix composite influences the mechanical properties of the composites. In this paper, we present the TRS-modulated tensile properties of continuous SiC fiber reinforced titanium (SiC/Ti) composite. The magnitude and distribution of TRS inside SiC/Ti were evaluated by using firstly a simple 1-D beam model considering fiber-matrix structure and then a full 3-D FEM model. The warping of the SiC/Ti specimen resulted from the asymmetrical fiber placements was used as a measure to verify the pertinence of the mechanical models. A 3-D FEM simulation accounting all TRS information gives a good prediction of the composite tensile properties.

**MMC(CMC)-13: The Effect of Pressure during Sintering on the Mechanical Properties of Hydroxyapatite**

S. KOBAYASHI, W. KAWAI, S. WAKAYAMA, Tokyo Metropolitan University,
E-mail: koba@ecommp.metro-u.ac.jp

Hydroxyapatite (HA) is known to be biocompatible and osteoconductive, and be able to be synthesized chemically. The objective of the present study, the effect of pressure during sintering on the mechanical properties of HA. HA were sintered using hot press at a uniaxial pressure ranging from 7.81 to 62.5 MPa at a maximum temperature of 1200°C with a heating rate of 10°C/min. The density of the HA increased with increasing pressure and saturated at the pressure of 31.2 MPa. 4 points boding tests and fracture toughness measurement with IF method were conducted on the ceramics to clarify the effect of uniaxial pressure. Bending strength decreased at the pressure >31.2 MPa. This result indicates that residual stress generated during sintering process become larger with increasing pressure. Fracture toughness were also lower with high density HA.

Coffee Break

**PMC-15: Processing of Neat Polycaprolactone and Polycaprolactone-Tricalcium Phosphate Particulate Composites by Selective Laser Sintering for Bone Tissue Engineering Applications**

B. PARTEE, S. HAS, S. HOLLISTER, University of Michigan,
E-mail: sumandas@umich.edu

Present tissue engineering practice requires the use of porous, biodegradable scaffolds to serve as temporary 3-D templates to guide cell attachment, differentiation, proliferation, and subsequent regenerate tissue formation. Such scaffolds are anticipated to play an important role in allowing physicians to simultaneously reconstruct and regenerate damaged human tissue such as bone, cartilage, ligament and tendon. Recent research in the area of tissue engineering suggests that the choice of scaffold material and its internal porous architecture significantly influence the type of regenerate tissue and its resulting mechanical properties. However, a lack of biomaterials processing and fabrication methods capable of meeting the complex geometrical and compositional requirements of tissue engineering scaffolds has slowed progress towards fully testing these findings. It is widely accepted that layered manufacturing methods such as selective laser sintering (SLS) have the potential to fulfill these needs. Polycaprolactone (PCL) is one of the most widely investigated biocompatible, biodegradable materials for tissue engineering applications. We have used SLS to fabricate complex tissue engineering scaffolds composed of neat PCL and its composites with hydroxyapatite (HA) and tri-calcium phosphate (TCP). Such scaffolds were found to be dimensionally accurate to within 3%-5% of design specification and near fully dense (>99%). Tensile and compressive mechanical properties of SLS processed PCL were evaluated and found to be comparable to published data. SLS was then used to fabricate mini pig and human condyle scaffolds directly from computationally optimized digital designs based on computed tomography of actual bone. We report on porous scaffold design and fabrication, optimal SLS processing parameter development, mechanical property measurements, and structural characterization via microscopical and micro-computed tomography.

**PMC-17: Effect of Water Absorption and Hydrolytic Degradation on Mechanical Properties for Polybutylene Succinate**

T. SAKAI, S. SOMIYA, Kaji University,
E-mail: small.sakai@hotmail.com

The paper was reported that Polybutylene Succinate resin (PBS), one of Biodegradable plastics, was immersed in pure water at various temperatures and was examined the changes of mechanical properties. Water absorption property at various temperatures followed Fick’s diffusion law at early stages. Moreover, bending strength and elastic modulus went down because of water absorption. As a result of FT-IR analysis, it was found that hydrolytic degradation was caused by water absorption with immersion time. The strength dropped drastically and the brittleness fracture was caused after hydrolytic degradation occurred to some extent. In addition, crystallinity was adjusted to reform the materials. By the increase of crystallinity, mechanical properties were increased and the speed of water absorption was inhibited. But, bending strength of high crystallinity fell down by being immersed for short time in pure water.

**PMC-18: Electrical and Mechanical Properties of CFRP/TP Compound**

K. OGI, T. NISHIKAWA, Ehime University; Y. OKANO, Panasonic Shikoku Electronics Industries; I. TAKETA, Toray Industries Inc.,