www.elsevier.com/locate/jmbbm

Mechanical characterization and validation of Poly (methyl methacrylate)/Multi walled carbon nanotube composite for the polycentric knee joint

S. Arun, S. Kanagaraj

PII: S1751-6161(15)00194-0
DOI: http://dx.doi.org/10.1016/j.jmbbm.2015.06.002
Reference: JMBBM1495

To appear in: *Journal of the Mechanical Behavior of Biomedical Materials*

Received date: 26 January 2015
Revised date: 30 May 2015
Accepted date:
1 June 2015

Cite this article as: S. Arun, S. Kanagaraj, Mechanical characterization and validation of Poly (methyl methacrylate)/Multi walled carbon nanotube composite for the polycentric knee joint, *Journal of the Mechanical Behavior of Biomedical Materials,* http://dx.doi.org/10.1016/j.jmbbm.2015.06.002

Mechanical characterization and validation of Poly (methyl methacrylate)/Multi walled carbon nanotube composite for the polycentric knee joint

S.Arun[a], S.Kanagaraj[a,*]

[a]Department of Mechanical Engineering,

Indian Institute of Technology Guwahati, Guwahati-781039, Assam, India

Abstract

The leg amputation in the active person is the most uncomfortable surgery in patient's life. Trans femoral amputation is one of them, which can be overcome using the prosthesis consisting of a socket, knee joint, pylon and foot. The artificial prosthetic knee joint imitates the functions of human knee to achieve the flexion-extension for the above knee amputee. The objective of present work is to develop a light weight composite material for the knee joint to reduce the metabolic cost of the patient. Hence, an attempt was made to study the mechanical properties of multi walled carbon nanotubes (MWCNT) reinforced Poly (methyl methacrylate) (PMMA) prepared through melt mixing technique and optimize the concentration of reinforcement. The PMMA nanocomposites were prepared by reinforcing 0, 0.1, 0.2, 0.25, 0.3 and 0.4 wt. % of MWCNT using injection moulding machine via twin screw extruder. It is observed that the tensile and flexural strength of PMMA, which were studied as per ASTM D638 and D790, respectively, were increased by 32.9 and 26.3 % till 0.25 wt. % reinforcement of MWCNT and then decreased. The experimental results of strength and modulus were also compared with theoretical prediction, where a good correlation was noted. It is concluded that the mechanical properties of PMMA were found to be increased to maximum at 0.25 wt. % reinforcement of MWCNT, where the Pukanszky model and modified Halpin-Tsai model can be used to predict the strength and modulus, respectively, of the PMMA/MWCNT composites. The said composite can be opted as a suitable materiel for the development of polycentric knee joint.

*Corresponding author. S.Kanagaraj
Department of Mechanical Engineering, IIT Guwahati, Tel: +91-361-2582676. E-mail: kanagaraj@iitg.ernet.in