ICAM2009

11th International Conference on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

Production and Characterization of Composites PMMA/Zro2 and PMMA/TiO2 for use as bone cement

G. A.O. Lopes(1) and S. N. Silva(2)

(1) Department of Materials Engineering, Centro Federal de Educação Tecnológica de Minas Gerais, e-mail: Lopes.gabriel@hotmail.com

(2) Department of Materials Engineering, Centro Federal de Educação Tecnológica de Minas Gerais, e-mail: sidneynicodemos@yahoo.com.br

Abstract – Were produced samples of the composites and of the comercial cement bone, in diferents proportions of reagents. Were made mechanical compression and tribology tests to determine the resistance to impacts and the coeficient of friction. As microscope for analysis of composite surface.Was realized the MMT test for evaluate biocompatibility. The composites developed showed resistance to compression similar to bone cement currently used by an average of 90 MPa. The pin on disk test determined the composite as a material with high coefficient of friction and surface photographic analysis showed that the composite has high resistance to wear and biocompatibility.

The polymethylmethacrylate (PMMA) cement is widely used as a biomaterial in the setting of prosthetic joints. For over 5 decades, bone cement has been especially important in restorative medicine in orthopedics, he works primarily as an element of connection of the prosthesis (metal or polymer) to the bone [1]. The commercial bone cements suffer gradual mechanical wear over time, and that means that he has a long useful life estimated in the literature today about 10 to 15 years. In Brazil, for reasons not yet identified exactly, this life cycle, according to preliminary studies is around 5 years [2]. As seen, the PMMA cement has a low performance today, so there are many research groups in the world, seeking to develop composites that are more durable in physiological system on the action of stress of loading. The relevance of this research is to initiate studies of this composite to bring that future improvements in the quality of life of thousands of patients in need of placement or replacement of prostheses, especially lowering the costs for the Unified Health Service (Brazil), which has spent hundreds of millions of money from medical procedures that could be avoided if the life of the prosthesis were increased. This study investigated the performance of a composite of PMMA with the addition of TiO2 and ZrO2 ceramics, to enhance its mechanical and biological properties The zirconium oxide (ZrO2) is one of the most studied material for ceramic processing which in general seeks to optimize the mechanical properties due to its structural behavior that prevents propagation of cracks in the material by the change of crystalline structure.Samples were produced with different proportions of reagents (monomer and copolymer) and addition of ceramic phases and stage-building, also being studied to control the polymer without the addition of zircon oxide. After the production of these samples were made the tests of mechanical compression. The following tests were conducted to pin on disk, to evaluate the tribology properties of the biomaterial. In vitro wear tests of MTT (cells of macrophages) were used to evaluate the biocompatibility of the biomaterial produced. The composite PMMA/Zro2 and PMMA/TiO2 showed a resistance to compression(120Mpa) more than the commercial bone cement (about 100Mpa). The wear of the composites produced were higher than PMMA, which indicates a more efficient materials produced. The materials produced were biocompatible. the tests reproduced the types of impacts caused by bone cement inside the human body, presented satisfactory results in relation to pre-established objectives.

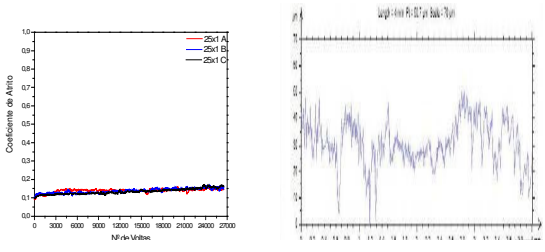

Figure 1: Graphic analysis of coefficient of friction and irregular surface of bone cement trade

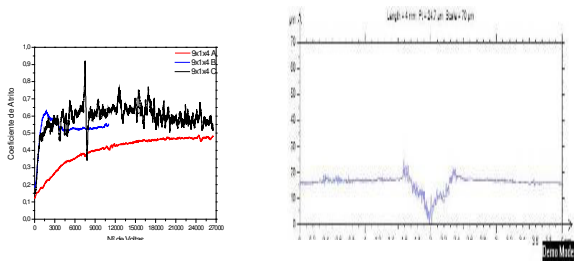

Figure 2: Graphic analysis of coefficient of friction and regular surface of the composite PMMA/ZrO2

[1] PEREIRA, Marivalda de Magalhães; MANSUR, Herman Sander; ORÉFICE, Rodrigo Lambert. Biomateriais : fundamentos e aplicações. Rio de Janeiro: Cultura Médica, 2006. 538 p.

[2] AZEVEDO, Cesar de Farias; HIPPERT, Eduardo. Retrieval and failure analysis of surgical implants in Brazil: the need for proper regulation, <http://www.ipt.br/atividades/servicos/chat/?ARQ=21>. Acesso em: 1/nov. 2007.