11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

New trend of epoxy polymers. An in vitro biological properties of epoxy polymers for medical applications

Filiberto González Garcia,[1*] Maria E.Leyva,[1] Olga Z. Higa,[2] Alvaro Antonio Alencar de Queiroz[1]

(1) Universidade Federal de Itajubá (UNIFEI), Departamento de Física e Química, Av. BPS 1303, 37500-903- Itajubá, Minas Gerais, Brasil. e-mail fili@unifei.edu.br * Corresponding author.
(2) Instituto de Pesquisas Energéticas e Nucleares da Universidade de São Paulo, IPEN/USP-Centro de Biotecnologia, São Paulo/SP, Brasil.

Abstract- This work describes the physicochemical, mechanical and *in vitro* biological properties of three epoxy networks based on diglycidyl ether of bisphenol-A (DGEBA) epoxy prepolymer cured with triethylenetetramine (TETA), 1-(2-aminoethyl)piperazine (AEP) and isophoronediamine (IPD) for total joint replacement. The mechanical properties were evaluated with respect to impact and flexural tests. Functionality rules the mechanical behavior of epoxy networks by increasing the crosslink density and the flexural modulus, increasing *Tg* and decreasing the chain flexibility and the impact resistance. The biological interactions between the obtained epoxy polymers and blood were studied by *in vitro* methods. Studies on the protein adsorption, platelet adhesion and thrombus formation is presented. The protein adsorption assays onto polymeric surfaces showed that the epoxy networks adsorbed more albumin than fibrinogen. The results about platelet adhesion and thrombus formation indicated that DGEBA-IPD and DGEBA-AEP networks exhibits good hemocompatible behavior. The materials revealed no signs of cytotoxicity to Chinese hamster ovary cells, showing a satisfactory cytocompatibility. Although citotoxicity assays suggest that the epoxy polymers are biocompatible materials

Total joint replacement (arthroplasty) is a common and very successful surgery for people with degenerative arthritis (osteoarthritis) of the knee. Contemporary prosthesis for total hip arthroplasty includes the use of high performance metallic prosthesis and a cement to promote direct adhesion between the prosthesis and bone. Epoxy resins have a wide range of excellent physical and chemical properties, which makes them essential for the development of new technologies in biomaterials science. Depending on the chemical structure of curing agents and the curing conditions, it is possible to obtain toughness, chemical resistance, mechanical properties ranging from extreme flexibility to high strength and hardness and high adhesive strength interesting to the development of new adhesive formulations for use in arthroplasty. The high initial adhesion properties of epoxy resins to metallic surfaces make these materials interesting to the development of bone cements for arthroplasty. The objective of this work was to evaluate the non-specific cell damage (cytotoxicity) of two epoxy formulations on cultured mammalian cells (CHO). The epoxy resin (DER 331, diglycidyl ether of bisphenol A, DGEBA) with an epoxide equivalent weight 187.5 was supplied by the Dow Chemical Co. of Brazil**.** Triethylenetramine (TETA) commercial product DEH 24, of Dow Chemical Co. of Brazil and aminoethylpiperazine (AEP) chemically pure, was supplied by the ACROS (USA)**.** The amine hydrogen equivalent weight (AHEW) was determined by potentiometric titration. The curing reaction between epoxy resin and the TETA or AEP occurs by step polymerization. For each adhesive formulation studied the appropriate amounts of the two components epoxy resin and the respective amines hardeners were completely mixed by stirring at room temperature (25 ^{o}C) until they formed a homogeneous mixture. From this solution, several samples were prepared by casting samples on a silicon mold to obtain epoxy plates and cured at room temperature for 24 h and after post-cured at 130 °C for 2h**.** The in vitro cytotoxic effects of epoxy adhesives based on TETA and AEP was studied in according to the ISO-10993 ‘‘Biological Evaluation of Medical Devices’’ standard. The culture medium was Chinese hamster ovary (CHO) cells in contact with diluted epoxy adhesives extracts. Both, TETA and AEP cured resins revealed no signs of cytotoxicity to Chinese hamster ovary cells, showing a satisfactory cytocompatibility.