BIOCOMPATIBILITY OF C-C COMPOSITES COVERED WITH PYC AND PHEMA

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The application of carbon-carbon composite materials as a biomaterial is mainly limited by its cost and brittleness of the matrix. The brittleness leads very often to the formation of microparticles in the tissue, which may cause inflammations around implants then. To prevent the releasing of carbon particles, C-C carbons have been covered by different layers. In our work we have studied the biocompatibility of C-C composite surface covered with pyrolytic carbon and pHEMA (Poly-Hydroxy Ethyl MethylAcrylate), synthetic polymeric hydrogel utilized for biomedical applications.

The specimens were reinforced with the carbon plane wave fabric from Torayca T800H fibres with the phenolic resin Umaform LE as a matrix precursor. The specimens were three times impregnated, recarbonized and infiltrated and covered with pyrolytic carbon. Final carbon-carbon samples were impregnated and covered with pHEMA solution in the autoclave.

The presence of pHEMA on the surface and in inner pores of composite was indicated with optical microscope and infrared microspectroscopy. The volume fraction of pHEMA in inner pores of composite was detected from polished cross-sections using image analysis method, 57% of all open coarse pores was penetrated with pHEMA.

Embryonal human lung fibroblasts were cultured on composites. Plastic Petri dishes for tissue culture were taken as a control surface. The metabolic activity of cultured cells, and the level of some cytokines were determined. The cells cultured on C-C carbons coated with pHEMA exhibited several times higher metabolic activity in comparison with the uncoated C-C composite. The cytokines were estimated by immunoreaction in medium after the cell cultivation. The levels of both inflammatory cytokines were higher in comparison with the control surface.

EFFECT OF THE γ-IRRADIATION DOSE RATE ON THE SUPRAMOLECULAR STRUCTURE OF UHMWPE

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Ultrahigh molecular weight polyethylene (UHMWPE) is used as a bearing material in total joint replacement (TJR). The unique structure of this polymer provides high resistance to creep and wear and excelent toughness. Nonetheless, the bearing (the pit) is still viewed as the weakest link of TJR, and so lifetime limiting factor. This fact is due to wear particles originating in articulation of the pit with associated metal components. These particles can initiate osteolysis of the surrounding bone, with results in loosening of the implant and consequently in its failure; therefore, a considerable effort has been made to improve wear resistance of the UHMWPE. It was shown that a proper mode of sterilization by ionising radiation can considerably increase the wear resistance, apparently due to cross-linking of polymer chains. However, the application of high energy radiation leads to many changes in the UHMWPE structure (as crystallization structure, supermolecular periodicity etc), and it is desirable to know how an irradiation mode affects structural parameters of this polymer.

While the effect of a radiation dose under various environmental conditions has been extensively studied for almost three decades, the effect of the irradiation dose rate has been studied rarely. In this contribution, besides the effect of a radiation dose in air and nitrogen, special attention was paid to the effect of the dose rate on the supermolecular structure of UHMWPE.

Samples for this experimental study were prepared from rods of medical grade UHMWPE (Poly Hi Solidur, BRD) by pressing and/or machining. The samples were irradiated with gamma emitter ^{60}Co. Five irradiation doses (25, 50, 100,150 and 200 kGy) were applied using two dose rates (0.25 and 2.5 kGy/h). X-ray scattering methods and differetial scanning calorimetry were used to follow structural changes in UHMWPE. The results obtained by these methods showed sensitivity of the UHMWPE structure to applied irradiation. Crystallinity increases with an irradiation dose similarly under air and under nitrogen. On the other hand, the growth of crystallinity is steeper in the case of a slower irradiation rate but the growth in crystallinity during this procedure is caused by thickening of crystalline lamellae and thinning of amorphous interlamellar layers.

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