HYDROGELS FOR SYNTHETIC ARTICULAR CARTILAGE APPLICATIONS OBTAINED FROM IONIZING RADIATION

[1]SÔNIA M. MALMONGE, [2]ÁLVARO A.A. DE QUEIROZ, [1]CECÍLIA A.C. ZAVAGLIA
[1]CEB/DEB-FEE-UNICAMP, PoBox: 6040, Campinas-SP. [2]IPEN/CNEN-SP, PoBox: 11049, São Paulo-SP.

INTRODUCTION

Biomaterials are a wide variety of materials which are foreign to the body and that can be used clinically in contact with biological fluids and tissues as implants for regeneration of articular cartilage deffects [1].

Synthetic polymers make up by far the broadest and most diverse class of biomaterials because their variety of compositions, properties, forms and also because they may be fabricated readily into complex shapes and structures [2].

Hydrogels are a class of hydrophilic polymers that can be defined as a polymeric materials which exhibits the ability to swell in water, but which will not dissolve [3].

Hydrogels with enhanced mechanical properties can be used to manufacture synthetic grafts for repair of articular cartilage lesion [4].

The chemical and physical combination of two or more structurally diferents polymers provides a convenient rout for the modification of properties to meet specific needs. The interpenetrating polymers networks (IPN) represent an interesting mechanism by which different polymers can be physically combined [5]

Synthesis of IPNs by using hydrophilic monomers results in hydrogels with enhanced mechanical properties.

The present work has described the preliminary study of the synthesis of a pseudo-interpenetrating polymer network (pseudo IPN), cellulose acetate/N,N-dimethylacrylamide, by using ionizing radiation.

EXPERIMENTAL

A pseudo-interpenetrating polymer network (pseudo IPN), was prepared by simultaneous irradiation of cellulose acetate/N,N-dimethylacrylamide (CA/DMAA) system in a ^{60}Co source. Thus, a sample of 30% and 6% DMAA and CA respectively in the presence of acetone was added into the glass ampoule.

After bubling nitrogen (N_2) in the solutions, the ampoules were sealed and irradiated with γ-rays in irradiation dose range 8-38 kGy and dose rate 1.78 kGy/h at room temperature. After irradiation, the samples were washed with water to extrate the solvent and monomer occluded in a Soxhlet extractor, dried in vacuum until constant weight.

The pseudo IPN samples obtained from different irradiation dose were analysed by infrared spectroscopy and thermal analyses. Infrared spectra were measured using a Perkin Elmer 1630 model. The glass transition temperatures of the synthesized products were determined using a DSC 2 DuPont calorimeter. The amount of water content of the samples were determined gravimetrically by immersing in distilled water at room temperature until equilibrium.

RESULTS AND DISCUSSION

The synthesis of pseudo IPN (CA/DMAA) systems in acetone solutions was studied in a irradiation dose interval of 7-38 kGy and dose rate 1.78 kGy/h at room temperature (25^{o}C).IR-spectroscopy measurements for the pseudo IPN systems show absorption bands characteristic for the structure of cellulose acetate (CA) and N,N-dimethylacrylamide (DMAA).

Considering the difference between the glass transition temperature of poly (N,N-dimethylacrylamide) (PDMAA) (387 K) and cellulose acetate (CA) (468 K) homopolymers, we thought that it could be of interest to analyse the glass temperature of pseudo IPN prepared, as the variation of Tg, with the irradiation dose of the samples. The glass temperature of the systems (Figure 1) increased with the irradiation dose indicating a decreasing in the chains flexibility.

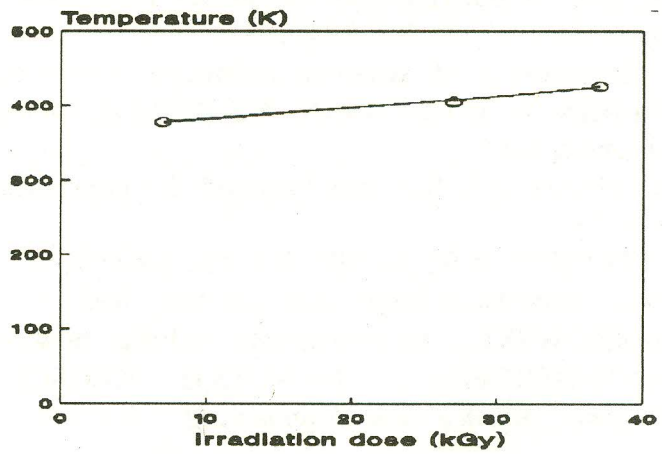

Fig. 1 - Relation between glass transition temperature and irradiation dose.

Figure 2 shows the water uptake as a function of irradiation dose. It can be seen that water content decreases gradually with irradiation dose. This may be due to an increase crosslinking density or an increasing on molecular weigth of the PDMAA.

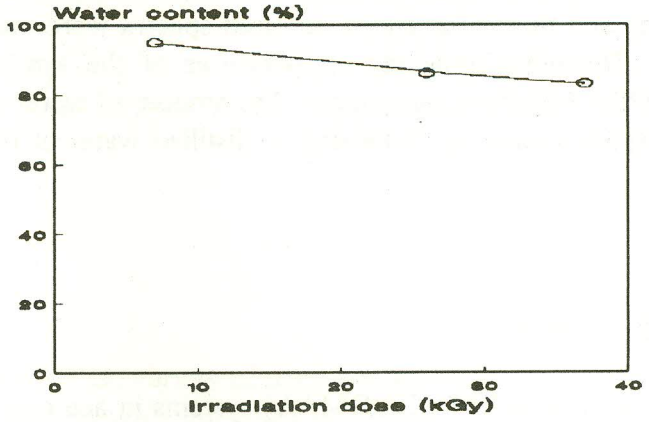

Fig. 2 - Relation between water content and irradiation dose.

The results showed that is possible to obtain pseudo interpenetrating polymer network hydrogels with different water uptake by controll of the irradiation parameters. The study of mechanical properties of these materials is in progress.

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