Surface Modification Of Polyurethanes By Radiation-Induced Grafting

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Polyurethanes (PUR) due to their structure/property diversity are considered as one of the most biocompatible materials known today \cite{1}. They are commonly used in medicine for production of scaffolds in tissue engineering and for manufacturing of medical devices, such as blood bags, vascular grafts, artificial hearts, many different catheters and mammary implants \cite{2}. However, the hemocompatibility and lubricity of PUR need to be improved for more clinically applicable blood-compatible surfaces because of its hydrophobic surface. The surface modification can be carried out by radiation grafting of hydrophilic monomers, chemical modification, immobilizing biological molecules and plasma treatment. It is generally known that, among these methods the modification by gamma irradiation seems to be the most promising, since this method gives good control of grafting yield and has the advantage of providing a clean modification, meaning that no initiator is needed \cite{3}.

The aim of this research was to modify the surface of polyurethanes by radiation-induced grafting. The samples used for grafting were synthesized from poly (ethylene-butylen adipate), diol end-capped with different molecular masses (M~1000 and 2000 Da), isophorone diisocyanate and 1,4-butanediol as a chain extender. The weight ratio between hard and soft segment was 40:60. The mutual radiation grafting of N-vinylpyrrolidone (NVP) onto polyurethanes films was performed. The influence of different parameters on the grafting yield was determined, e.g., monomer concentration, solvent composition, addition of mineral acids, effect of mineral acid concentrations, effect of dose etc.

Nongrafted and grafted polyurethanes were characterized by Attenuated Total Reflection Fourier Transform Infrared Spectroscopy (ATR-FTIR), Contact Angle measurements (CA), Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA) and Atomic Force Microscopy (AFM).

The preliminary results showed that radiation-induced grafting is an environment-friendly method to modify the surface of polyurethanes for biomedical applications. Satisfactory results concerning grafting yield were obtained at low dose-rate and doses, in the presence of air and with low monomer concentration in water. Surface hydrophilicity of the PUR film was enhanced by grafting of hydrophilic NVP. It was observed that contact angle measured in water decreased about 15-20\% after grafting.

References

\cite{3}. Alves, P.; Coelho, J.F.J.; Haack, J.; Rota, A.; Bruinink, A.; Gil, M.H.; European Polymer Journal, 45, 1412-1419, 2009