

Surface characterization of Polymeric Biomaterials processed by Reactive Ion Etching (RIE) plasma sterilization

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Statement of purpose: Several medical devices made of different polymers are sterilized by ethylene oxide gas or ionizing radiation. However, toxicity and mechanical problems regarding these technologies have been described in the literature. This situation has greatly raised interest regarding low-pressure gas plasma sterilization in recent years. Although plasma sterilization has demonstrated efficient ability on killing resistant microorganisms, there is a need to know the safety of this sterilization method for polymer damage. The purpose of this work was to evaluate possible surface modification and oxidation of different types of polymers used as biomaterials of medical devices.

Methods: Materials used in this study were new single-use medical devices made of: polyvinylchloride, polyurethane, polycarbonate and polyethylene. Samples were exposed to plasma sterilization using a reactive ion etching (RIE) system and under gradual exposition times of 10, 20 and 30 minutes. Oxygen containing gases used were the following: pure oxygen and oxygen/hydrogen peroxide. The pressure used was 0.1 Torr, radio-frequency powers of 100 and 150watts and gas flow of 200sccm. To evaluate surface topography and defects, it was used a Scanning Electron Microscopy (SEM), as well as a Fourier Transform Infrared (FTIR) equipment to study changes and damage in surface chemical composition of samples. Visual inspection was performed to detect possible gross aspect of the samples processed.

Results / Discussion: Visual inspection of the control samples and samples treated by RIE plasma system revealed a clear difference in coloration between them. Observation at scanning electron microscopy (SEM) pointed certain changes in surface appearance and topography, and their degree was higher as the exposition times and radio-frequency power increased, for both gas and gas mixture. Fourier Transform Infrared (FTIR) spectra of samples treated showed absorption bands characteristic of oxidized chemical groups as hydroxyl, peroxide and hydroperoxide.

Conclusions: This study has shown that Reactive Ion Etching (RIE) plasma sterilization promote alterations in the surface composition and morphology of the biomaterials exposed under all the combination of parameters. This way, further studies must be performed in order to investigate the influence of these modifications in the medical devices biocompatibility.

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