



Electron Beam Induced Functionalization of Fluoropolymers

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Ionizing radiation affects the properties of polymers by chain scission and cross-linking reactions. One process will usually predominate, depending on the chemical structure of the polymer and the irradiation conditions such as temperature and atmosphere. Poly(tetrafluoroethylene) (PTFE) and the perfluorinated copolymers poly(tetrafluoroethylene-co-hexafluoropropylene) (FEP) and poly(tetrafluoroethylene-co-perfluoropropylvinyl ether) (PFA) undergo predominantly chain scission, if the irradiation is performed at room temperature. This shortcoming is exploited by converting PTFE into low molecular weight micropowders. The irradiation of PTFE in the presence of air results in micropowders functionalized with oxygen-containing groups [1]. The concentration of end groups was investigated by FTIR and ^{19}F solid-state NMR. The data were used to calculate number-average molecular weights.

It was demonstrated that PTFE can be cross-linked by irradiation above its crystalline melting temperature in an oxygen-free atmosphere [2,3]. Evidence for cross-links in PTFE was derived directly from structural information using ^{19}F solid-state NMR [4]. FEP is understood to undergo cross-linking by irradiation above the glass transition temperature [5]. It was found that also PFA can be branched and cross-linked by irradiation under special conditions [6,7].

Radiation-induced grafting of styrene into fluoropolymer films and subsequent sulfonation offers an attractive way to prepare proton exchange membranes. Recently, radiation-induced grafting into cross-linked PTFE was reported [8-10]. Modified FEP, PFA and ETFE films have been used as base material in this study. The modified films have been prepared by irradiation in nitrogen atmosphere at different temperatures up to temperatures above the melting temperature of the fluoropolymer.

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