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Gas permeation and diffusion in copolymers of tetrafluoroethylene and hexafluoropropylene: effect of annealing

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ABSTRACT

Two novel perfluorinated materials, copolymers of tetrafluoroethylene (TFE) and hexafluoropropylene (HFP), were prepared and studied. In both copolymers the prevailing comonomer was HFP. The copolymers are completely amorphous and similar by their properties to poly(hexafluoropropylene) studied earlier. A detailed investigation of gas permeation parameters (permeability and diffusion coefficients) was conducted both at ambient temperature and in the range 22-50°C. For comparison, additional measurements of temperature dependencies of transport parameters were performed for annealed films of poly(hexafluoropropylene). On the Robeson diagrams for gas pairs He/H₂, He/CH₄ the data points of the 'as cast' films of the copolymers were located between Upper Bounds (UB) of 1991 and 2008. However, annealing of the copolymers resulted in a dramatic increase in selectivity, so the data points shifted above UB-2008 on these diagrams as well on those for the gas pairs H₂/CH₄, N₂/CH₄ and He/N₂. This makes these copolymers interesting candidates for separation gas mixtures containing He and H₂.

Keywords: copolymer; tetrafluoroethylene; hexafluoropropylene; permeability; diffusion

1. Introduction

In spite of success of industrial membrane gas separation processes there are several non-solved problems that attract attention of the researchers. One of them is the recovery of helium from natural gases or industrial streams such as mixtures of H₂

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