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Mechanical and gas transport properties of uniform strained polyetherimides films

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Abstract

The general trend of membrane materials science is to find relations between chemical structure of elementary unit and gas transport parameters of polymers, but there are many observations, that permeability and selectivity of polymers significantly depends on films prehistory. Recently for some polyetherimides (PEI) was shown dramatic dependence between gas permeability and selectivity and regime of residual solvent removing and film contraction. Biaxial induced deformation of films was chosen as a model of this process. There were two amorphous glassy thermoplastic PEI: PEI-1 and PEI-2 (Ultem) with different glassy temperature and chain rigidity to explore influence of controlled uniform deformation chosen. The PEI-1 and Ultem with residual solvent film samples casted from solution were dried under vacuum and room temperature until stable weight and the film samples annealed in vacuum oven under atmosphere pressure until stable weight above glassy temperature during several hours were exposed by uniform deformation. A uniform strained PEI film samples with adjusted deformation value were obtained by strain in plastic metal matrix under room temperature original method. The mechanical characteristics and gas separation parameters of unstrained and strained PEI films with residual solvent and annealed PEI films were systematically investigated. It was demonstrated that annealing and straining both of PEI films leads to increasing mechanical parameters, chain packing ordering, decreasing gas permeability and increasing gas selectivity. More rigid Ultem films straining leads to material properties changing barely from small strain value from brittle destruction to plastic deformation appearing. It was also observed chain packing ordering under increasing strain value with increasing gas separation selectivity and minor decreasing permeability simultaneously. Thereby obtain and strain film modes for optimal combining gas separation parameters are determined by polymer chain rigidity and residual solvent content.