

论文

渗透物在致密聚合物膜中扩散的分形介质模型

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摘要:

利用自由体积理论讨论了渗透物分子在致密聚合物膜内的扩散机理, 提出了“扩散通道”的概念, 建立了渗透物在致密聚合物膜中扩散的分形介质模型, 考虑了自由体积分布对扩散过程的影响. 根据建立的模型, 渗透物在膜内的扩散是由在“扩散通道”上的一系列跳跃构成的. 根据致密膜内扩散通道的关联长度 $\xi(p)$ 与膜厚L的关系, 可以把扩散分为正常扩散、过渡扩散和分形扩散三部分, 给出了扩散相图, 提出并解释了分形跨越现象.

关键词: 聚合物膜; 扩散; 自由体积; 逾渗; 分形跨越

A Fractal Model on the Diffusion of Small Molecule Penetrants in Dense Polymer Membranes

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Abstract:

The mechanism of small molecule penetrants in dense polymer membranes was described on the basis of free volume theory and the concept of diffusion path was presented. The statistical character of diffusion path was related with the size of penetrant molecules, the temperature and the free volume of membranes according to the percolation theory. Then a novel fractal model was developed to describe the diffusion of small molecule penetrants in dense polymer membranes. According to this fractal model, the diffusion of penetrant consisted of a series of active jumps in the diffusion path, and the diffusion behavior could be classified to three types: fractal diffusion, transition diffusion and normal diffusion. The fractal diffusion together with transition diffusion was called anomalous diffusion. The phenomenon was called fractal crossover that the diffusion of penetrants transformed from the fractal diffusion to the transition diffusion or the normal diffusion was analyzed.

Keywords: Polymer membrane; Diffusion; Free volume; Percolation; Fractal diffusion

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