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研究论文

聚丙烯酸类水凝胶的制备及其在碱性溶液中的pH敏感性

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摘要: 以 $(\text{NH}_4)_2\text{S}_2\text{O}_8$ 和 NaHSO_3 为氧化-还原引发剂、N,N'-亚甲基双丙烯酰胺(MBA)为交联剂,采用自由基水溶液聚合方法,分别合成了聚丙烯酸(PAAc)、聚丙烯酰胺(PAAm)和系列丙烯酸(AAc)质量分数(f_{AAc})不同的聚丙烯酸-co-聚丙烯酰胺(P(AAc-co-AAm))水凝胶。进而分别对其在碱性缓冲溶液和NaOH溶液中的pH敏感行为进行了探讨。结果表明, PAAc和P(AAc-co-AAm)凝胶在2种溶液中均具有优良的pH响应行为,且在NaOH溶液中的溶胀比大于缓冲溶液中;而PAAm凝胶仅在NaOH溶液中具有pH敏感性。2种溶液中,随 f_{AAc} 的增加, P(AAc-co-AAm)凝胶的平衡溶胀比(ESR)增大;但在缓冲溶液中,当 $f_{\text{AAc}} \geq 20\%$ 时, P(AAc-co-AAm)凝胶的溶胀行为与PAAc相似,而当 $f_{\text{AAc}} < 20\%$ 时,其溶胀则同时表现出PAAc和PAAm凝胶的溶胀特性。溶胀机理分析表明,凝胶的溶胀主要受聚合物网络内静电排斥作用和离子屏蔽效应控制。

关键词: 高分子材料 水凝胶 pH敏感性 丙烯酸 丙烯酰胺 溶胀

Preparation of Polyacrylic Acid Type Hydrogel and Its pH Sensitive Behavior in Alkaline Solution

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Abstract: A series of pH sensitive poly(acrylic acid-co-acrylamide) hydrogels with different acrylic acid mass fraction (f_{AAc}) were synthesized by the free radical polymerization. The swelling behavior of these hydrogels was studied in alkaline buffer solution and NaOH solution with different pH values, respectively. The results showed that the poly(acrylic acid) (PAAc) and poly(acrylic acid-co-acrylamide) (P(AAc-co-AAm)) hydrogels exhibit the excellent pH sensitivity and their equilibrium swelling ratios (ESR) in NaOH solution are higher than those in buffer solution, whereas the poly(acrylamide) (PAAm) only presents the pH sensitivity in NaOH solution. In the two kinds of solution, the ESR of P(AAc-co-AAm) hydrogels increased with the increasing of f_{AAc} in polymer. Furthermore, in the buffer solution, the swelling behavior of P(AAc-co-AAm) hydrogel acts as similar as PAAc when the $f_{\text{AAc}} \geq 20\%$, while it exhibits analogous swelling characteristics as PAAc and PAAm when the $f_{\text{AAc}} < 20\%$. The swelling behaviors of hydrogels synthesized are mainly controlled by the electrostatic repulsive and the ion shielding effects in polymer network.

Keywords: polymer materials hydrogel pH sensitivity acrylic acid acryamide swelling

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