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论文

玻璃芯片上温控微阀的制备和微流体控制性能研究

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摘要:

聚*N*-异丙基丙烯酰胺(PNIPAAm)在临界温度(32 ℃)附近会发生敏锐的相变, 导致其体积和表面亲疏水性的突变. 利用这种由温度刺激引起的体积变化, 可以控制微通道内微流体的运动状态. 本文以2-羟基-2-甲基-1-苯基丙酮为引发剂, 水-乙醇混合体系为溶剂, 在玻璃芯片通道内局部区域以紫外光诱导聚合PNIPAAm整体柱塞, 制备温控微阀. 系统地考察了聚合条件对该阀的形态和性能的影响. 在此基础上, 建立了一个芯片上的集成化单温控阀流动注射分析模型, 利用镁离子与荧光探针*O,O'*-二羟基偶氮苯的螯合荧光反应, 表征温控微阀的控流效果. 结果表明, 所制作的微阀温控效果良好, 在微流控领域有应用前景.

关键词: 聚*N*-异丙基丙烯酰胺 温控微阀 微流控芯片 流动注射分析

Preparation and Characterization of Thermally Actuated Microfluidic Valve on Glass Microchips

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Abstract:

Poly(*N*-isopropylacrylamide)(PNIPAAm) undergoes a rapid phase transition at its lower critical solution temperature(32 ℃), leading to sharp changes in its volume and surface wettability. The thermally responsive volume change behavior of the PNIPAAm can be used to manipulate the microfluids in microchannels. In the present work, PNIPAAm monolithic plugs, serving as the thermally actuated microfluidic valve, were prepared by photoinitiated polymerization within the channels of a glass chip. Photo-polymerization of the N-isopropylacrylamide monomer in water/ethanol was carried out using 2-hydroxy-2-methyl propiophenone as the photo-initiator. The polymerization conditions for the thermally actuated microfluidic valve and its fluid-manipulating behavior were systematically investigated. Based on these investigations, a protocol of on-chip-integrated micro-flow injection(μFIA) system equipped with a single thermally actuated microfluidic valve was established. The analytical performance of the μFIA system was demonstrated with the chelating reaction between the magnesium(Ⅱ) and the fluorescent agent *O,O'*-dihydroxyazobenzene. Experimental results show that the mirofluidic valve behaved well for the flow control and was promising in the field of microfluidics.

Keywords: Poly(*N*-isopropylacrylamide) Thermally actuated microfluidic valve Microfluidic chip Flow injection analysis

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参考文献:

1. FANG Zhao-Lun(方肇伦). Microfluidic Analytical Chips(微流控分析芯片)[M], Beijing: Science Press, 2003: 56—89
2. Seller K., Fan Z. H., Flurk K., *et al*.. Anal. Chem.[J], 1994, 66: 3485—3491
3. WU Zhi-Yong(吴志勇), FANG Fang(方芳). Chem. J. Chinese Universities(高等学校化学学报)[J], 2008, 29(2): 283—287

4. Unger M. A., Chou H. P., Thorsen T., *et al*.. Science[J], 2000, 288: 113—116
5. Leach A. M., Wheeler A. R., Zare R. N., *et al*.. Anal. Chem.[J], 2003, 75: 967—972
6. Tokeshi M., Minagawa T., Kitamori T., *et al*.. Anal. Chem.[J], 2000, 72: 1711—1714
7. XU Yi(徐溢), ZHANG Jian(张剑), ZHANG Wen-Pin(张文品), *et al*.. Chem. J. Chinese Universities(高等学校化学学报)[J], 2008, 29(5): 892—896
8. HUANG Yan-Zhen(黄艳贞), FANG Qun(方群), LI Dan-Ni(李丹妮). Chem. J. Chinese Universities(高等学校化学学报)[J], 2004, 25(9): 1628—1631
9. Cai Z. X., Chen H. W., Chen B., *et al*.. Talanta[J], 2006, 68(3): 895—901
10. Gil E. S., Hudson S. M.. Prog. Polym. Sci.[J], 2004, 29: 1173—1222
11. Yu C., Mutlu S., Selvaganapathy P., *et al*.. Anal. Chem.[J], 2003, 75: 1958—1961
12. Singh D., Kuckling D., Choudhary V., *et al*.. Polym. Adv. Technol.[J], 2006, 17: 186—192
13. YUAN Guang-Xin(苑广信), HE Qiao-Hong(何巧红), CHEN Heng-Wu(陈恒武), *et al*.. Chinese J. Anal. Chem.(分析化学)[J], 2006, 34(12): 1693—1696
14. MENG Fei(孟斐), CHEN Heng-Wu(陈恒武), DOU Yue-Hua(窦跃华), *et al*.. Chem. J. Chinese Universities(高等学校化学学报)[J], 2004, 25(5): 844—846
15. Diehl H., Olsen R., Spielholtz G. I., *et al*.. Anal. Chem.[J], 1963, 35(9): 1144—1154

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1． 汪维鹏,倪坤仪,周国华 .连接反应介导的等位基因特异性扩增-微流控芯片电泳法同时检测多个SNP位点[J]. 高等学校化学学报, 2006,27(10): 1856-1858
2． 贾宏新,王世立,徐章润,方肇伦 .微流控芯片流动注射气体扩散分离光度测定系统的研究 [J]. 高等学校化学学报, 2006,27(9): 1621-1625
3．陈莉,李世庚,肖飞,张爱华,姚康德 .温敏性壳聚糖共聚膜的制备与细胞吸附/脱附行为[J]. 高等学校化学学报, 2008,29(5): 1061-1064
4．穆金霞, 殷学锋, 陈文章.用顺序注射系统控制微流控芯片中的Edman降解[J]. 高等学校化学学报, 2008,29(10): 1977-1981

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