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研究论文

微流控芯片流动注射气体扩散分离光度测定系统的研究

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摘要 提出了纳升级进样量的微流控芯片流动注射气体扩散分离光度检测系统. 制作三层结构微流控芯片, 在玻璃片上加工微反应通道, 用聚二甲基硅氧烷[Poly(dimethylsiloxane), PDMS]加工气体渗透膜和具有接收气体微通道的底片, 实现了生成气体的化学反应、气-液分离和检测在同一微芯片上的集成化. 采用缝管阵列纳升流动注射进样系统连续进样, 用吸光度法测定NH^+_4以验证系统性能. 结果表明, 该系统对NH^+_4的检出限为140 μmol/L(3σ), 峰高精度为3.7%(n=9). 在进样时间12 s、注入载流48 s和每次进样消耗200 nL试样条件下, 系统分析通量可达60样/h. 若加大样品量到800 nL, 使接收溶液停流1 min, 该系统对NH^+_4的检出限可达到35 μmol/L(3σ), 但分析通量降低到20样/h.

关键词 微流控芯片 气体扩散分离 流动注射分析

分类号 0657

A Microfluidic Chip-based Flow Injection System with Gas Diffusion Separation and Photometric Detection

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Abstract A microfluidic chip-based flow injection system with a three-layer structure for performing gas diffusion separation was developed, using a glass substrate to fabricate the reaction channels, and PDMS to fabricate the gas-permeable membrane as well as acceptor channel-structured layers. Gas generation reaction, gas-liquid separation and analyte detection were integrated on the same chip. Samples were introduced to the microfluidic chip by using a slotted vial array nanoliter flow injection system. The system was applied to the photometric detection of ammonium ion after transformation to ammonia gas in basic medium and collection in weakly acidic acceptor stream to change the color of the bromothymol blue indicator. Sampling throughput of 60 sample/h was achieved with a sample consumption of 200 nL for each cycle. A reproducibility of 3.7% RSD(n=9) was achieved with a detection limit of 140 μmol/L NH^+_4(3σ). The detection limit was improved to 35 μmol/L NH^+_4(3σ) by increasing sample volume to 800 nL and employing a stopped flow mode for the solution.

Key words Microfluidic chip Gas diffusion separation Flow injection analysis

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