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Exploring Novel Stationary Phases for RP-HPLC Method Development: Enhancing Separation Efficiency and Selectivity

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Abstract: *Reversed-phase high-performance liquid chromatography (RP-HPLC) is a widely used technique for separation and analysis in various fields, from pharmaceuticals to environmental monitoring. The development of novel stationary phases has emerged as a pivotal strategy to enhance separation efficiency and selectivity, addressing the ever-increasing demand for improved analytical performance. This review article delves into the exploration of novel stationary phases for RP-HPLC method development and their impact on separation efficiency and selectivity. The utilization of innovative strategies, such as surface modification, nanostructures, and monolithic columns, has revolutionized stationary phase design. These approaches have led to remarkable improvements in chromatographic performance by tailoring the physicochemical properties of the stationary phases. Surface modification techniques enable the introduction of specific functional groups and surface chemistries, enhancing selectivity towards target analytes. Nanostructures, including superficially porous particles, provide increased surface area and optimized mass transfer, resulting in improved efficiency and resolution. Monolithic columns, with their interconnected porous structures, offer rapid separation and reduced backpressure.The impact of these novel stationary phases on separation efficiency and selectivity is profound. Enhanced efficiency is achieved through reduced analysis time, increased resolution, and improved peak shapes. Moreover, the selectivity of RP-HPLC methods can be fine-tuned by designing stationary phases with tailored characteristics, enabling precise separations of complex mixtures and challenging analytes. These advancements have opened new avenues for method development, allowing for the analysis of a wide range of compounds with higher sensitivity and accuracy.*

Keywords: Reversed-phase high-performance liquid chromatography (RP-HPLC), novel stationary phases, separation efficiency, selectivity, surface modification, nanostructures, monolithic columns, method development

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