

Development and characteristics of polymer monoliths for advanced LC bioscreening applications: A review

Abstract

Biomedical research advances over the past two decades in bioseparation science and engineering have led to the development of new adsorbent systems called monoliths, mostly as stationary supports for liquid chromatography (LC) applications. They are acknowledged to offer better mass transfer hydrodynamics than their particulate counterparts. Also, their architectural and morphological traits can be tailored in situ to meet the hydrodynamic size of molecules which include proteins, pDNA, cells and viral targets. This has enabled their development for a plethora of enhanced bioscreening applications including biosensing, biomolecular purification, concentration and separation, achieved through the introduction of specific functional moieties or ligands (such as triethylamine, N,N-dimethyl-N-dodecylamine, antibodies, enzymes and aptamers) into the molecular architecture of monoliths. Notwithstanding, the application of monoliths presents major material and bioprocess challenges. The relationship between in-process polymerisation characteristics and the physicochemical properties of monolith is critical to optimise chromatographic performance. There is also a need to develop theoretical models for non-invasive analyses and predictions. This review article therefore discusses in-process analytical conditions, functionalisation chemistries and ligands relevant to establish the characteristics of monoliths in order to facilitate a wide range of enhanced bioscreening applications. It gives emphasis to the development of functional polymethacrylate monoliths for microfluidic and preparative scale bio-applications.