Production polystyrene micro-emulsion as template for monolith synthesis

ABSTRACT

Monolith have received much attention as high-performance chromatographic matrices due to its convective mass transfer and interconnected porous structure. Biodegradable polymers, free radicals and cross-linkers are among the templates used to form pore structure. However, poor heat dissipation and uneven pore size distribution across monolith remain as a key challenge in monolith fabrication. Therefore, this study aims to synthesize and characterize polystyrene micro-emulsion as template for monolith. The operating conditions for the synthesis of the polymeric micro-emulsion, that includes polymer concentration (14 - 35 wt %), surfactant concentration (1 - 9 wt %), temperature (30 - 70oC) and stirring rate (500 - 1000 rpm), were designed using Response Surface Methodology (RSM). The characterizations of resulting particles were observed using Scanning Electron Microscopy (SEM) and Inverted Microscope. The sizes of the particles were determined within range of 5.9 - 11.7 μm. Out of the 30 tested samples with different operating conditions, observation under the inverted microscope indicated homogenous particles of polystyrene microemulsion while some forming aggregations. Sample that was synthesized using 21 wt% polymer, 3 wt% surfactant, stirring rate at 875 rpm and heated at 40 oC resulted homogenous particles with particle diameter ranging from 7.92 μm to 8.80 μm. Good particle homogeneity was also obtained at a higher polymer concentration (35 wt %) using similar surfactant concentration and operating temperature at slower stirring rate (625 rpm). Samples aggregation were observed when using 35 wt % polymer, 7 wt % surfactant heated at 50oC at 750 rpm as well as sample under parameter of 25 wt% polymer wt % surfactant for 60oC stirring at 875 rpm. The findings of the study provide useful insights on the feasibility of polymeric micro-emulsion particles as a directing template for monolith fabrication with structured pores.