Development of a multichannel separation device with an electrochemical detection for possible application in diagnostics of dopamine metabolism-related diseases

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Precursors and metabolites of dopamine belongs to one class of very similar compounds and consequently it is difficult to separate them all in a one single analysis on polymer-based monolithic stationary phases. Therefore, optimization of a surface chemistry of stationary phases is necessary to improve selectivity of the separation. Surface chemistry of polymer-based monolithic stationary phases can be easily controlled by either a composition of the polymerization mixture or post-polymerization surface modification.

In this work we have used former approach to prepare four individual monolithic stationary phases providing different retention of ten precursors and metabolites of dopamine. Zwitterion functional monomer with various dimethacrylate crosslinkers were used to prepare stationary phases applicable in both reversed-phase and hydrophilic interaction retention mechanisms. A composition of the mobile phase has been optimized by means of window diagram to find one mobile phase providing separation with the highest possible resolution of all compounds on all columns. Each column provided separation with different elution order and one to three unresolved peak pairs. However, after combination of four individual separation traces all ten compounds can be easily resolved.

Hence, sample has been simultaneously injected on four monolithic capillary columns into optimized mobile phase. To allow instant detection, miniaturized electrochemical detectors made of carbon fiber as a working electrode and a silver microwire as a reference microelectrode have been integrated at the end of each column.

In the final step, we have applied the same approach in the development of 3D printed titanium separation device. The four channels of the chip have been filled with prepared monolithic stationary phases and after integration of the electrochemical detection an injection of a sample has been tested.