Utilizing properties of thiol-ene materials for microfluidic devices for analytical and pharmaceutical applications

Jörg P. KUTTER*

University of Copenhagen

Gold statement

Thiolenes are interesting polymers for fabrication of microfluidic chips as well as for functional units in or on those chips. These materials offer the possibility for surface modification via click chemistry and can be rendered compatible with many, even harsh, solvents. Thus, they are ideally poised for many microfluidic applications in the life sciences.

Introduction

A number of challenges remain for microfluidic devices, often connected to material choices. As soon as we explore other materials than glass – and for most applications, polymer materials are to be preferred – there are potential issues with, e.g., the electroosmotic flow, solvent compatibility, non-specific adsorption, or auto-fluorescence. Other challenges can include bonding problems, pressure capabilities and, especially for chromatography, to provide a suitable stationary phase.

Body

Thiolene-based materials are almost ideal to offer ways to overcome most of these challenges. These materials are based on two or three monomers, which are often mixed in non-stoichiometric ratios. This ensures, among other things, that functional groups are accessible on the surfaces of the materials after polymerization, and thus allow straightforward surface modifications using click chemistry reactions. This opens for a range of surface modification procedures, to either provide a certain functionality, or to remedy specific challenges. For chromatography, emulsions of the monomer mix can be prepared either classically to yield porous monolith type stationary phase supports, or microfluidically to produce highly monodisperse particles that can then be “packed” and immobilized by a second short polymerization step. Also, it is often neglected to provide high quality interfaces to other functional units, such as, e.g., a sample preparation unit, or a detection unit, in order to not degrade separation performance. We have developed dead-volume free interfaces to combine, e.g., solid phase extraction to electrophoretic separation and an ESI tip, or fast labeling with efficient enzyme reactors, all based on the thiolene material platform.

Conclusion

Thiolene-based microfluidic devices show high promises for applications such as protein analysis, toxicological studies, drug delivery and cell-based assays.