PO2013

Tailor-made surfaces in microfluidic channels by microplasma

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Microplasma-activated chemical vapor deposition (µPA-CVD) at atmospheric pressure can be used for tailoring the inner surfaces in dielectric microfluidic channels. “Tailoring” refers both to the layer properties and to the localization of deposition within a channel system. An area-selective control of surface properties is not only possible along the fluid flow direction: In a Y- or T-shaped channel, for example, surface free energies can even be controlled individually for the opposing surfaces of the main channel, close to the branching point. Such coated microchannels allow the production of low-cost fluidic separators for multiphase mixtures. The separation performance of the separators was determined for various flow parameters and investigations to the layer stability were made.
Furthermore, there is the requirement for using droplet-based microfluidics that the aqueous phase does not wet the hydrophobic surface. The particular challenge is that the aqueous phase often contains proteins, which accumulate preferentially at the hydrophobic channel surfaces. The µPA-CVD of fluorocarbon-based coatings could meet these requirements, the layers are additionally sufficiently mechanically stable, so that the coatings provide several hours of continuous operation.
For the homogeneous or localized µPA-CVD in different microchannel geometries the deposition kinetics for the used precursors and process gases mixtures are of particular importance. For a better understanding of the influence of parameters such as channel geometry, gas velocity, precursor concentration, electric field strength in the discharge area and duty cycle ratio of the electrode voltage layer thickness profiles in flow direction were measured in different channels. The knowledge of the deposition kinetics allows to limit or to extend the uniform coating area in microchannels by controlling the process parameters.

Keywords
microfluidics
microplasma
separator
droplet based
atmospheric pressure