556i Vapor-Based Polymer Coatings for Surface Engineering of Microfluidic Devices

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Polymer-based micro- and nanofluidic devices have increasingly been used in materials science, chemistry, medicine, and biology; mainly due to straightforward fabrication and compatibility with rapid prototyping. However, some polymer-specific shortcomings have limited wider applicability of such devices. For instance, many polymers used for the fabrication of microfluidic devices, such as polydimethylsiloxane (PDMS), are hydrophobic; making it difficult to fill narrow channels with aqueous buffers. In addition, the native PDMS is chemically inert and promotes non-specific protein adsorption. The lack of functional groups limits the range of applicable surface modification methods. While there is a range of well-established surface modification protocols available for glass or silicon, generally applicable methods are less established for polymers. Functional poly(p-xylylenes) (reactive polymers) synthesized via chemical vapor deposition (CVD) provide an alternative to existing approaches, such as plasma treatment or grafting, because the resulting CVD polymer coatings provide a designable interlayer that is stable under the conditions of bioassays. Herein, we will introduce a simple method for the fabrication of discontinuous surface patterns within microfluidic systems based on vapor deposition of a photodefinable coating (PPX-CO-Ph) on the luminal surface of a microfluidic device followed by a photopatterning step. The resulting CVD coatings are characterized using X-ray photoelectron spectroscopy,infrared spectroscopy, and ellipsometry, As a proof-of-concept application, spatially controlled non-fouling surfaces are created on three dimensional microchannels and adsorption of fibrionogen and albumin is assessed. Moreover, the usefulness of CVD polymers for coating of previously assembled devices is demonstrated.