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Digital surface modifications for microfluidics and biosensor applications

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Switching from glass to polymer and paper based microfluidics and biosensors gives rise to challenges related to a.o. fluid dynamics control, bonding and adhesion. One way to address these particular challenges is local surface engineering by means of micro plasmas. Area-selective surface modifications by atmospheric pressure micro-plasmas allow cost-effective surface energy tailoring and chemical functionalization. Plasma patterning technologies are utilized in combination with fluid dispensing and inkjet printing in semiconductor backend and flexible electronics manufacturing, but can also be implemented in microfluidics, biosensor and tissue engineering applications. InnoPhysics has developed and commercializes the µPlasmaPrint technology, which enables area-selective functionalization by means of a dot-wise patterned plasma treatment and plasma deposition of nanocoatings with a resolution down to 150 µm. µPlasmaPrint utilizes a printhead with a multitude of micro-discharge at atmospheric pressure which can be independently activated according to digitally programmed a pattern. By controlling the discharge gas environment a multitude of processes can be applied such as the functionalization and the deposition of silicon-oxide-like materials for surface energy control and epoxy- and amine-containing coatings for biomaterial immobilizations on not only polymer surfaces but also glass, silicon and paper substrates. The basics of µPlasmaPrint will be discussed and a number of processing examples will be shown that demonstrate wettability improvements as enabler for controlled fluid dispensing/printing, the control of fluid transport, the adhesion and immobilization of biomaterials and the creation of metal and diamond structures, in particular, in the context of the application in microfluidics and biosensors. Finally, recent results of patterned microplasma assisted atomic layer deposition of TiO_2 films using the µPlasmaPrint technology will be presented.

Keywords
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