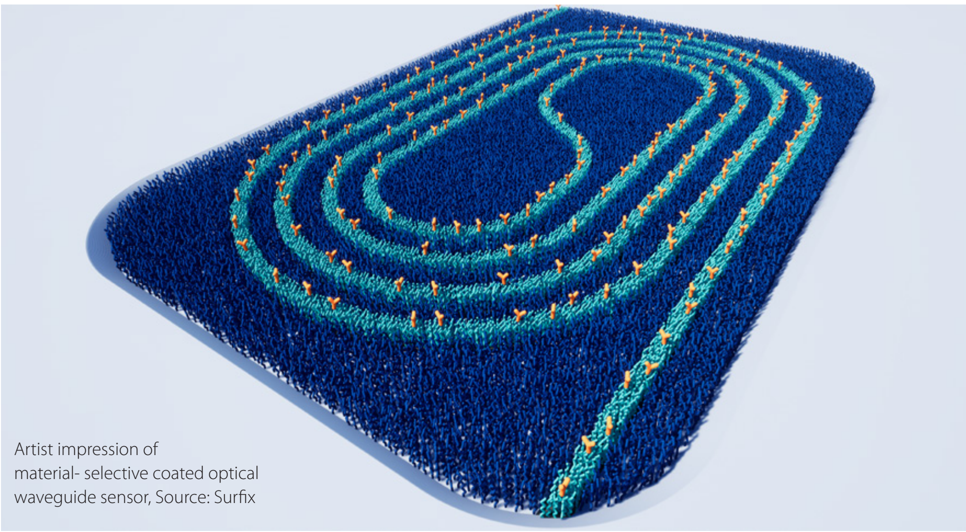
Nanocoatings with global impact

Micro- and nanotechnology are an integral part of sustainable solutions for major global challenges in healthcare, food, and energy. A well-known example is the development of devices for point-of-care diagnostics and other lab-on-a-chip applications. To exploit the full potential of these devices and their components such as biosensors and microfluidics, accurate control of surface properties is a prerequisite.

To this end, Surfix is developing nanocoatings that enhance the performance of micro- and nanodevices in life science applications.

Small structures, large surfaces

Surface properties are an important aspect of micro- and nanodevices, which by definition have a large surface-to-volume ratio. Surface modification provides control over essential properties of materials and devices in biological applications, such as wettability, non-specific adsorption of biomolecules (biofouling), and specific biorecognition (biofunctionalization). For many applications, local control of these surface properties offers benefits over uniform coatings. For example, by creating patterns of hydrophobic and hydrophilic areas, liquids can be confined and directed. Local control of biomolecular surface interactions offers great opportunities for biosensing and emerging applications such as organ-on-a-chip. Surfix addresses these surface modification needs by developing custom uniform or patterned nanocoatings based on a portfolio of proprietary technologies.

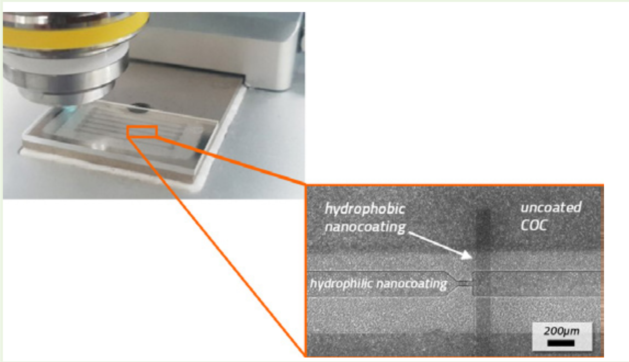


Artist impression of material- selective coated optical waveguide sensor, Source: Surfix

Nanocoatings for microfluidics

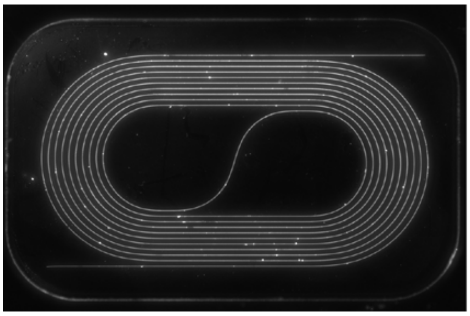
Glass and (thermoplastic) polymers are widely used for the fabrication of microfluidic chips. However, proteins tend to adsorb non-specifically to these materials, causing biofouling issues. Thermoplastics are suitable materials for high volume production of microfluidics by injection molding. However, common polymers such as COP/COC (cyclic olefin polymer/copolymer), PC (polycarbonate), and PMMA (polymethyl methacrylate) are hydrophobic, which hampers the capillary flow of aqueous biological liquids through the channels. These problems with non-specific adsorption and wettability can be overcome by applying a nanocoating to the channel wall that has both hydrophilic and antifouling properties. The possibility to create patterned nanocoatings yields local control over these surface properties, enabling advanced applications. For example, the flow of liquids can be controlled and directed by combining hydrophobic and hydrophilic nanocoatings in a single device. Application of coatings in microfluidic channels often interferes with the bonding of devices. A patterned nanocoating enables the local surface modification of the channel only, leaving the bonding surface uncoated. This improves the compatibility of the coating and bonding processes and the manufacturability of polymer microfluidic devices with enhanced surface properties.

Coated microfluidic chip. Source: Micronit and Surfix



Nanocoatings for biosensors

To ensure that a biosensor detects the analyte of interest, a specific bioreceptor needs to be immobilized on the sensor surface. Surface modification is therefore a key step. Depending on the sensor technology and the application, the properties of the biofunctionalization coating, e.g. thickness, density of bioreceptors, have to be tuned to achieve the highest possible sensitivity and selectivity. Moreover, in many cases detection does not take place on the whole sensor surface, but on a smaller sensing area. For example, in optical biosensors based on Si_3N_4/SiO_2 waveguides, only analyte molecules binding to the Si_3N_4 are detected, while this material makes up less than 1 % of the total sensor surface. Therefore, it makes sense to use a patterned material- selective nanocoating and immobilize the bioreceptor only on the Si_3N_4. At the same time, the surrounding SiO_2 can be coated with an antifouling layer to prevent non-specific adsorption. In this way, the analyte is concentrated on the waveguide, thus enhancing the sensitivity and limit of detection



Optical waveguide sensor material-selectively coated with fluorescently labelled proteins Source: Lionix and Surfix

By bringing the right surface properties to the right location, the performance of microfluidics and biosensors can be improved and new applications for the next generation of micro- and nanodevices can be addressed.

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