

Coating Applications – Lab on a Chip (LOC)

[Kristen Taton](#), [Christopher Holland](#) – April 26th, 2021

Introduction

Innovative Surface Technologies (ISurTec) developed PhotoPrime SR[®] 330 Primer to bond hydrophilic coating to a broad range of medical and biotech devices. This technology has found additional uses as an adhesion layer across a number of interesting applications, including drug eluting catheters and lab on a chip technology. This article discusses the lab-on-a-chip (LOC) application.

Challenges

A biotechnology company was developing an innovative handheld diagnostics system for lab-quality point of care (POC) detection of biomarkers in blood. They powered their system by using magnetoresistive sensing to detect when target biomarkers were present between a silicon chip and magnetic particles. This lab-on-a-chip required binding biomolecules (proteins, DNA, small molecules) to the silicon nitride chip surface.

This technology created a trifecta of challenges for surface modification. The first challenge stemmed from the substrate being a silicon (nitride) chip. Silicon nitride is a protective coating used on printed circuit boards to reduce wear and insulate the circuitry from harm. It has high strength and hardness, wear and corrosion resistance, as well as thermal and chemical stability. These same properties make it challenging as a substrate for coatings - low surface energy, low reactivity, and high surface tension, all of which create barriers to successful covalent bonding.

The second and third challenges stemmed from the application. To detect the biomarkers, both the particles and the surface needed to have corresponding biomolecules on their surfaces that bind the biomarkers, i.e, a tether-biomolecule. These biomolecules are not stable to harsh chemicals used in typical chip fabrication techniques and work best when they are held away from the surface so that they have room to maintain their 3D conformation. In addition, the coating technology must not interfere with the magnetic detection.

Hence the company was faced with a situation where their tether-biomolecule coating would just wash away from the silicon nitride surface and needed a strong but biocompatible, gentle, and magnetically-inert binding agent.

Solution

After finding no suitable candidates for binding biomolecules to silicon chips, the biotechnology company approached ISurTec to solve their dilemma. ISurTec worked directly with the company to recommend chemistry that the company could do in its own lab, brainstorm design ideas, and perform experiments in ISurTec's labs. After the initial discussions and experimentation ISurTec believed PhotoPrime SR 330 primer would anchor the tether molecule effectively.

Coating Applications – Lab on a Chip (LOC)

PhotoPrime SR enables binding a substance photochemically to an underlying substrate. It was originally designed for silicone rubber, a particularly challenging substrate. Because silicone rubber exhibits some of the same underlying properties as silicon nitride, namely low surface energy and low reactivity which limit conventional bonding techniques, ISurTec believed it would enable bonding to silicon nitride. Furthermore, its use in medical devices guaranteed its biocompatibility while ISurTec's testing also confirmed that it was magnetically inert.

ISurTec tested its hypothesis successfully and presented the results to the company.

Result

The biotech company performed a test experiment to validate ISurTec's proposal. They coated PhotoPrime SR 330 primer on a blank set of silicon nitride chips, and cured the coating with ISurTec's standard UV curing protocol, then in further steps, photoimmobilized the tether molecule and printed DNA. The DNA was stable on the surface and active – it hybridized complementary DNA to create a strand. After successful demonstration of the coating technology, the company integrated PhotoPrime SR into the assembly of their handheld sensor and further testing showed that when biomarkers passed over the sensors, the company's proprietary detection created a magnetic signal in relation to the quantity of biomarker present. Ongoing tests showed that PhotoPrime SR provided extended biocompatibility and conductive properties which enhanced the sensing field.

As a result of their innovative technology and approaches, supported by use of PhotoPrime SR 330 primer, the biotech company successfully released a fully functional product and received industry recognition for its pioneering and innovative technology.

About Innovative Surface Technologies, Inc.

Founded in 2004, ISurTec began with creating the first pre-mixed, ready-to-use hydrophilic coatings for the medical device market, significantly reducing cost and complexity for the industry. Today ISurTec is a global leader in surface modification technologies for medical devices and biotech applications, manufacturing hydrophilic coating solutions sold under the ISurGlide®, Lubricent®, PhotoPrime®, and Tylicent® brand names as well as ISurCell™ ultra-low attachment and ISurTherm® thermoresponsive cultureware products. ISurTec's ready-to-use and custom coatings have been used by over 100 small and major medical device manufacturers both in the US and overseas. ISurTec manufactures all coating solutions locally in Minnesota and routinely partners with customers to develop tailored coating solutions for specialty applications. Contact team@isurtec.com for more information.