Polymer Thick Film Biosensors

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Single-use biosensors originated in the medical industry where devices coming in contact with human tissue must be sterilized or discarded after use. Since disposal after use eliminates the need for sterilization, single-use sensors make the test very simple, a key factor in the adoption of the technology for home glucose testing. Although the medical market accounts for over 90% of all single-use biosensor sales, the range of possible tests suggests whole new markets could emerge. Developments in food and beverage, environmental and animal health care industries indicate single-use biosensors are positioned for a strong future. The most common single-use biosensor format is based on enzyme electrode principles. The test is accurate, accomplished rapidly and can be done frequently, anytime and anywhere. A key requirement for cost effectiveness, however, is that biosensors be inexpensive.

Polymer thick film (PTF) inks contain a dispersed or dissolved phase. They achieve final properties by simple drying. When printed and cured on a substrate, a specific electronic or biological function develops in the dried film.

The ink consists of four distinct groups of intermediates, which are thoroughly mixed and blended, yielding a homogeneous product.Functional Phase consists of metal powders (Pt,Pd,Ag,Au, etc.) in conductive inks, metals and/or metal oxides (RuO_2, Bi_2 Ru_2O_7, Pd, Ag) in resistors and ceramic/glass ($BaTiO_3$, glass) in dielectric temperature firing. Binder Phase to hold the ink to the ceramic substrate, and merges with the ceramic during high temperature firing. Vehicle acts as the carrier for the powders and is composed of both volatile (solvents) and non-volatile (polymers) organics. These evaporate and burn off during the early stages of drying and firing, respectively. Modifiers are small amounts of proprietary additives which control behavior of the DuPont inks before and after processing.

The printing screen is prepared by stretching stainless steel wire mesh cloth across the screen frame and attaching it, maintaining high tension of the mesh. An organic emulsion is then spread over the entire mesh, filling all open areas. A common practice is to add 0.5 mil additional emulsion on the mesh. The area to be screen printed is then patterned on the screen. These screens can be purchased from your supplier already patterned, or you may choose to do it yourself.

As the squeegee moves the ink across the screen, a shearing action causes a decrease in viscosity, allowing the ink to pass through the patterned areas, onto the substrate. As the squeegee passes, the screen peels away and the ink viscosity recovers, leaving a well defined print.

Printed on flexible substrates, PTF products are compact, lightweight, environmentally friendly, inexpensive and lend themselves to highly efficient manufacturing techniques. They can be folded, twisted, bent around corners or bonded to any surface making them ideal for applications where flexibility is needed. The technology is suitable for small features and layers can be printed on top of each other to develop multiple functions. Polymer thick film technology as become the preferred choice for printing electrodes and other components of disposable biosensors. As the need for cost-effective solutions becomes more important, PTF fits the bill.

Resources
www.dupont.com/mcm/product/biospt1.html
www.g-e-m.com
chemsens.mase.nagasaki-u.ac.jp