Commentary

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Bioelectronics Printing Innovation for Secluded Manufacture of Biosensors

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Biosensors are analytical devices that incorporate biological components as well as physicochemical detectors. Biosensors have been widely used in a variety of fields, including the food industry, environmental testing, and medical testing, due to their advantages in high sensitivity and automation and integration. A biosensor is typically made up of a bio-receptor, a transducer that converts biological signals to physical signals such as optical or electrical signals, and electronic systems that combine technologies from life science, analytical chemistry, engineering, material science, and information technology, among other disciplines. Significant efforts have been made in recent years to identify alternative materials, structures, and modification methods for improving biosensor performance in terms of sensitivity, linear range, and detection limit. However, the complex procedures of biosensor fabrication limit their development and use.

There are currently three representative technologies for fabricating bioelectronics sensors. Screen printing is a printing method that uses a squeegee to force a liquid paste through a mask to form a pattern onto the substrate surface, and it has become popular due to the ease of fabrication on an industrial scale. However, one significant limitation of the screen-printing fabrication method is the need for skilled printers and the high cost of small-scale production. Indeed, screen printing has largely been limited to flat surfaces, which may limit the method's potential utility in the biosensors fields. Micro fabrication methods, such as film deposition, photolithography, etching, bonding, and molecular self-assembly, enable highly reproducible mass fabrication of biosensors with complex geometries and functionalities. Sweat analysis, tear analysis, and saliva analysis are all common uses for these biosensors.

The micro fabrication method, on the other hand, is limited by its complex processing procedures and the need for large machines and a cleanroom. Furthermore, 3D printing refers to a variety of processes in which photo-sensitive materials are deposited, joined, or solidified under computer control to produce a three-dimensional object, where materials such as plastics, liquids, or powder grains are added together layer by layer. However, it suffers from a scarcity of printing materials. Furthermore, none of these methods can achieve direct fabrication and functionalization with bioactive materials, reducing the efficiency of biosensor research and development. As a result, developing a method for small-scale biosensor production that simplifies the fabrication and functionalization process is critical.

Movable type printing is a printing system with a long history that uses movable components to reproduce the elements of a document, typically on paper. Making a reverse style of a single character, picking out words according to the manuscript, arranging the words in the font plate, and finally printing with ink are the steps in the general procedure of movable type printing. The typeface could be recycled after printing for use in the next typesetting. Inspire by this work, we propose a biosensor fabrication method that could benefit from simple fabrication and flexible assembly of bioelectronic component master moulds, as well as direct preparation of bioactive materials without complex surface modification. Furthermore, simultaneous detection of multiple metabolites is critical. Diabetic patients, for example, may experience a variety of complications, including lactic acidosis, a dangerous disease with a high mortality rate. There have been few reports of simultaneous detection of lactate and glucose. Researchers used micro-fabrication to create a microfluidic chip-based electrochemical system for simultaneous monitoring of glucose, lactate, and ascorbate in the rat brain. This method, however, suffered from complex processing procedures and complicated system design. We present a movable type bioelectronics printing technology here by going through the steps of biosensor design and master mould preparation, transfer printing, and post-transfer treatment. This movable bioelectronics printing technology has advantages in terms of repeatability, ease of modification and assembly for biosensor fabrication, and direct fabrication with bioactive materials on both rigid and flexible substrates. To demonstrate the capability and performance of the fabrication method, we created a dual-channel electrochemical biosensor for simultaneous monitoring of lactate and glucose to aid in the management of these metabolite concentrations and the avoidance of lactic acidosis. We believe that movable type bioelectronics printing technology could aid in biosensor prototyping and small-scale production.