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Short Commentary Open Access

A New Pico-Litre Fluid Dispensing Technology for New Possibilities

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Introduction

Biosensors more often than not require the manipulation of liquids, either to produce a biosensor itself, or to facilitate the biosensor's operation. As technological progress is made, the volumes of fluid involved have reduced and continue to do so. Reactions which may have previously required milli-litres now are accomplished using micro-litre, nano-litre and pico-litre volumes of reagents and biomaterials. There is an increasing desire for more reaction data points, cost savings in terms of material usage, a reduction in physical laboratory space requirements and miniaturization in general. To this end, the use of pico-litre volumes of fluids, where the biology and chemistry support it, is a logical step. Recently a new fluid handling instrument has been made available which is capable of dispensing pico-litre and low volume nano-litre volumes of fluid with high precision and accuracy. The PolyPico technology is not novel in being able to dispense pico-litre and nano-litre volumes of fluids, however it is novel in being able to do so by using disposable plastic cartridges. The advantages of such include being able to avoid the potential cross-contamination risks and the washing process associated with other pico-litre dispensing technologies. Furthermore, the new technology can dispense fluids with viscosities much higher than many of the predecessor technologies can. Is this significant? It is if you want a more compact biosensor, which use less material or if the current tools available will not dispense your reagents in the ultra-low volumes you require. If you want to explore the new possibilities which working at lower volumes offers without the expense of potentially clogging expensive non-disposable dispensing devices such as glass based piezo-electric dispensing systems, then inexpensive disposable cartridges are a welcome alternative. Biosensor research and development can be challenging at the best of times, with many unknowns from the onset and many constraints imposed by the materials and processes involved. Having a more adaptable and flexible means of handling ultra-low volumes of fluid helps to accelerate progress and ultimately success in the miniaturization of biosensors and assays in general.

The Technology

The PolyPico technology utilizes an acoustic means to precisely dispense pico-liter volumes of fluid from an orifice at the end of a plastic disposable dispensing cartridge (Figure 1). The dispensing cartridge are supplied empty and can be loaded with any suitable reagent using a standard laboratory pipette. Materials such as proteins/antibodies, DNA, living cells, nano-materials and a great many reagents can be dispensed with a precision of +/- a few pico-liters and a CV of 2 or better. By way of example, micro-drops of 50 pl in volume can be dispensed at a rate of 1000 droplets per second, which equates to a dispensing volume rate of 50 nl per second. However, both the micro-drop volume and dispensing rate can be varied to suit the application at hand. Fluids with a viscosity up to 70 cps can be easily dispensed, while it is possible to dispense fluids with a viscosity up to 100 cps if the application does not require mono-stable micro-drop dispensing. To put fluid viscosity, or the 'thickness' of the fluid, in perspective, consider that the viscosity of water is 1cps, while the viscosity of DMSO is 2 cps (Table 1). An important requirement when using this technology, as with most micro-drop dispensing technologies, is the avoidance of dust or other large particulate contamination. Such contamination may be avoided through good laboratory practices or the fluids may benefit from filtering pror to use. It is recommended that particles in the fluid to be dispensed should be no larger than 1/3 the diameter of the dispensing cartridge orifice. However, particles (or cells) larger than 1/3 the diameter of the dispensing cartridge orifice, can be dispensed if special measures are taken. Currently cartridges are available in a variety of orifice sizes from 50 um to 120 um.

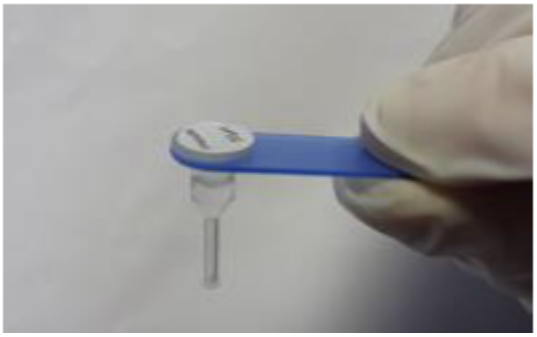

Figure 1: Dispensing cartridge.

Fluid	Approx. viscosity in Centipoise (cps) at 20°C
Acetone	0.3
Methanol	0.6
Benzene	0.6
Ethanol	1
Water	1
Mercury	1.38
Nitrobenzene	1.8
Propanol	1.9
DMSO	2
Ethylene glycol	16
Cream	20

Sulfuric acid	24
Propylene glycol	40
Sunflower oil	64
Olive oil	81

Table 1: Example viscosities of fluids.

The Applications

There are a vast number of possible biosensor applications, as well as applications in the areas of: drug discovery; PoC diagnostic device manufacture; microarray printing; DNA amplification; printing of living cells to isolate single cells or to create tissues [1]; printing of monomers [2]; printing of nano-materials features; mass spectrometry; creation of dilution series; and the dispensing of dilute low viscosity UV curable adhesives.

In conclusion, the PolyPico technology is a new ultra-low volume fluid dispensing technology to help you get the result that you want.

References

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