Portable microfluidics based on hyperelastic materials

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Following the development of microfluidic systems in the last decades, there has been a high tendency towards developing lab-on-a-chips with the goal of performing biochemical assays on a consumable fluidic chip connected to portable platforms for point of care applications. In this field, many kinds of microfluidic systems are fabricated from soft silicon (PDMS) that makes the integration of microvalves and micropumps [1] easier. More recently, materials that exhibit deformability capabilities much larger than the one of PDMS have been introduced in different growing applications such as soft robots [2] or sensors [3].

The purpose of this work is to demonstrate how hyperelastic materials can address some challenges in the field of point-of-care applications. A first illustration is given here based on a new digital microfluidics approach which involves collapsible chambers using a stretchable membrane for addressing complex protocols (ELISA). An elastomer is a key material with which the chambers, having a large range of volume (µl to few 100µl), can be filled and emptied totally at low pressures (few hundreds of mbar) using a portable pneumatic instrumentation (Fig1-right).

A second illustration is a new method for producing low-cost microfluidic devices using an original composite made of a polyurethane-based open cell foam (Bulpren PPI 90, Recticel) and a hyper-elastic silicon rubber (Dragon Skin FX Pro). From these materials, we are able to produce fluidic channels in a fully deformable chip. As an example, a blood typing protocol can be performed by moving manually a simple roller that induces a peristaltic effect upon a soft fluidic network (Fig 1-left).

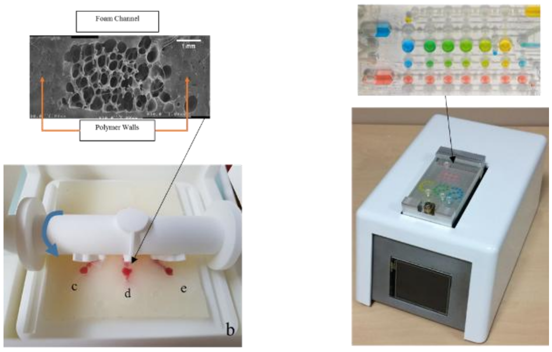

Figure 1: Foam based (left) and digital (right) portable microfluidic platforms using hyperelastic material

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