New strategies for the integration of complex bioassays in digital microfluidic devices

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Digital microfluidic devices offer the interesting prospect to perform complex bioassays at high-throughput by handling nanoliter-size droplets with a high degree of flexibility. However, many challenges must still be solved before this technology reaches the maturity necessary for advanced point-of-care applications [1]. For example, most devices demonstrated to date are too simple to handle simultaneously the numerous fluids required for typical bioassays and lack the reliability required to for complex assays. Herein we discuss new strategies that could help to overcome these limitations. We first describe how complex digital microfluidic devices with multiples level of metallization can be fabricated rapidly using SU8 photoresist as the dielectric. We show that SU8 not only offers excellent electrical properties and ease of patterning but can also be deposited with no specialized and costly equipment, which is a very significant advantage the fabrication of single-use and low-cost devices. We also demonstrate that the reliability of the fluidic operations can be improved drastically by using a simple strategy based on the encapsulation of the droplets in a thin shell of oil [2]. Finally, we present examples of bioassays that could be performed using the developed digital microfluidic devices for DNA and protein identification.

[1] R. B. Fair, "Digital microfluidics: is a true lab-on-a-chip possible?", Microfluid Nanofluid, vol. 3, pp. 245 - 281, 2007.

[2] D. Brassard, L. Malic, F. Normandin, M. Tabrizian, and T. Veres, "Water-oil core-shell droplets for electrowetting-based digital microfluidic devices". Lab Chip, vol. 8, p. 1342-1349, 2008.