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RESEARCH PAPER

Centrifugal automation of a triglyceride bioassay on a low-cost hybrid paper-polymer device

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Abstract We present a novel paper-polymer hybrid construct for the simple automation of fundamental microfluidic operations in a lab-on-a-disc platform. The novel design, we term a *paper siphon*, consists of chromatographic paper strips embedded along a siphon microchannel. The *paper siphon* relies on two main interplaying forces to create unique valving and liquid-sampling methods in centrifugal microfluidics. At sufficiently low speeds, the inherent wicking of the paper overcomes the rotationally induced centrifugal force to drive liquids towards inwards positions of the disc. At elevated speeds, the dominant centrifugal force will extract liquid from the siphon paper strip towards the edge of the disc. Distinct modes of flow control have been developed to account for water (reagent) and more viscous plasma samples. The system functionality is demonstrated by the automation of sequential sample preparation steps in a colorimetric triglyceride assay: plasma is metered from a whole blood sample and incubated with a specific enzymatic mixture, followed by detection of triglyceride levels through (off-disc) absorbance measurements. The successful quantification of triglycerides and the simple fabrication offer attractive directions for such hybrid devices in low-cost bioanalysis.

Keywords Lab-on-a-disc · Centrifugal microfluidics · Paper microfluidics · Point of care diagnostic · Triglyceride assay

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1 Introduction

Paper microfluidics has garnered attention for the development of low-cost point-of-care diagnostic devices in the scientific community (Ballerini et al. 2012; Fu et al. 2011) as well as for commercial purposes (Fulmer 2012). Besides the game-changing cost advantage of the material, paper devices offer further benefits when compared to conventional substrates such as silicon, glass or plastics, such as an easier pathway towards fabrication (Carrilho et al. 2009; Martinez et al. 2010) and remarkable capabilities for dry reagent storage and surface functionalization (Ge et al. 2012; Kwong and Gupta 2012). In the last few years, the field of paper microfluidics has brought various innovative, low-cost and rapid engineering solutions to biodiagnostics (Arnaud 2012; Liana et al. 2012; Shah et al. 2013). Furthermore, due to the wide range of inherent advantages of using paper like flow control through wicking and inherent