LOW-COST METHODS OF ON-DEMAND FLUID FLOW, NEMATODE EGG SEPARATION AND COUNTING

ABSTRACT

There is an increasing interest to re-invent device technologies for use in actual field applications where resources may be limited. Numerous examples exist in the medical and agricultural industry where the demand and benefits for on-the-spot methods of sample collection, preparation, and characterization is getting recognized by the scientific community. Some key attributes of devices that cater to this demand of on-the-spot testing are portability, low cost, disposability, easy fabrication and storage, simple operational procedure, and reasonable sensitivity and selectivity.

Within the abovementioned realm of device technologies, the thesis attempts to provide low-cost alternative methods for two applications: (i) fluid flow in paper microfluidic devices and (ii) nematode egg separation and counting.

Chapter 1 presents a technique to control and operate fluid flow between multiple paper substrates by employing a folded paper cantilever strip. The paper strip is mechanically actuated by a small fluid droplet. The technique can be scaled up to accomplish multiple colorimetric tests, and is demonstrated for the parallel detection of three analytes (glucose, nitrite, and protein). This actuator is intended for use in paper microfluidic devices to quantify levels of disease biomarkers.

Chapter 2 describes a method to separate nematode eggs from dirt particles followed by counting the number of eggs within a fluid suspension. Nematode eggs with similar-sized dirt particles are collected from a series of soil processing steps. Conventionally, through a staining procedure and sucrose centrifugation, a relatively cleaner dirt suspension with eggs is obtained that is later counted manually on a microscopic slide. Here we present a method of density-based

centrifugation that seems to provide better efficiency in separating the eggs from the dirt particles. Egg counting from large-volume fluids is accomplished on a scanner with a custom imaging software that recognizes and counts the number of eggs.

In summary, the use of paper substrates is advocated in the thesis because they are considerably cheaper than polymeric substrates and can be easily fabricated, molded, stored, transported, and imaged. For both applications, the methods presented here could be adopted in the field setting and integrated with other procedures of sample preparation and characterization.