Portable cell sorting and counting device

Country of origin | Italy

Health problem addressed
Developing countries are suffering most from the two global diseases HIV/AIDS and malaria. A great bottleneck is the lack of dedicated, mobile, robust, easy-to-use and low cost diagnostic equipment for CD4+ T cell enumeration and for the counting of parasitized erythrocytes in the blood, respectively.

Product description
An integrated solution for cell counting is proposed to bring innovative techniques directly to where they are needed most. It relies on dielectrophoresis, a method for cell handling and sorting without physical contact, exploiting the dielectric properties of cells suspended in a microfluidic sample under the action of electric fields.

Product functionality
A silicon-based platform has been developed with microfabricated electrodes customizable for specific diagnostic needs; the non-uniform electric field for cell manipulation is generated by microelectrodes, patterned on the silicon substrate of microfluidic channels, using microelectro-mechanical-systems (MEMS) technology.

Developer’s claims of product benefits
The number of CD4+ T cells per microliter of blood is used for HIV staging. The standard for cell enumeration is flow cytometry of lymphocyte subpopulations using antibodies. Although high throughput and accurate, its cost and technical requirements have limited its use in resource-limited areas worldwide. A simple and portable microfluidic lab-on-chip device would be of great benefit.

Malaria diagnostic indicator is the counting of parasitised erythrocytes in the blood. Microscopic inspection of blood smears for parasitised cells is the most applied diagnostic method. Integrated mobile diagnostic lab-on-chip instruments, small, robust, automatic and low-cost would be of great benefit.

Operating steps
The lab-on-chip will be pre-charged with the requested reagents. A drop of blood will be introduced and processed by dielectrophoresis. Integrated electronics will elaborate and show the results. The lab-on-chip core will be a disposable cartridge, while the handheld reader will be reusable for the following diagnostic tests.

Development stage
A modular platform based on a silicon substrate has been developed. It is composed of functional units with different electrode geometries. Characterization modules allow the determination of cells’ dielectric properties, while manipulation stages perform basic operations as cell filtering, focusing, caging, deviation and concentration. The modules can be rearranged on a single chip and produced with a standardized, cost-efficient technology. Custom electronics for electrodes excitation have been developed, with a custom optical unit for replacing the traditional microscope and observing cells on chip. Preliminary testing experiments were performed using yeast cells and blood cells.

Future work and challenges
The solution is at a research stage and organized in functional modules for cell analysis, sorting and concentration arrangeable on a single chip depending on the target application. The company working on the project currently holds patents covering the technological background. For the specific applications of AIDS and malaria detection, further development is under evaluation and the role of possible third parties involved in the development of the project considered.

Use and maintenance
User: Nurse, physician, technician
Maintenance: No training will be required for maintenance of the technology: the lab-on-chip core will be a disposable cartridge, while the handheld reader will be reusable for the following diagnostic tests.

Product specifications
Consumables: The lab-on-chip core will be a disposable cartridge.
Other features: The technology is portable, the cartridges single-use, the handheld reader reusable.

Environment of use
Setting: Rural and urban health care facilities, in the field.
Requirements: The lab-on-chip core operates cell separation. A sensor for cell detection can be included in the same package. Driving electronics can be assembled in a compact and battery powered handheld device.

The technology utilizes software and may be battery-powered.

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