

A complete molecular diagnostic test on a compact disc

A challenge in health diagnosis today involves the rapid analysis of genomic information in tests called molecular diagnostic assays. These tests can analyze a person's bodily fluids to determine the cause of sickness, and can detect a range of sicknesses from the common flu to malaria. Fast turnaround times can enable patients to receive diagnosis and treatment at the point of care, saving time and money for patients and hospitals. However, these tests are often complex and contain many steps, making it difficult to make a diagnosis in a short period of time. To speed things up, a compact centrifugal microfluidic platform is used, similar to a CD you would put in your personal computer. However, instead of miniature grooves for holding data, this plastic disc contains fluidic chambers and channels to process biological samples for disease diagnosis.



Fig. 1. A quadrant of a centrifugal microfluidic device made from clear polycarbonate plastic.

Genomic information takes the form of nucleic acids (NA) and generally requires multiple processing steps before it can be read and a disease diagnosis can be made. Some of the steps done on a microfluidic CD include: Mixing of the sample with various liquid and dry reagents; cell lysis, where the cell wall is broken to release NA; volume definition, where the sample or reagent is portioned into specified required volumes; density based separation, where the CD acts like a centrifuge to separate different components, such as in whole blood; cell sorting or concentration; NA amplification, where a series of heating and cooling steps copy the target DNA strand to achieve a large, detectable quantity; and detection of target molecules, including nucleic acids.

The microfluidic CD is capable of handling and manipulating a variety of fluids. Within about an hour, a sample from a nasal swab or a drop of blood can yield a complete disease diagnosis. The disc is also completely sealed and self-contained, eliminating any risk of contaminating the environment, and, due to its radial symmetry, it is capable of performing multiple tests on the same disc. With the microfluidic CD, patients can receive immediate diagnosis on a number of different diseases, speeding up treatment, saving money, and saving lives.

While promising, designing a molecular diagnostic assay on a microfluidic compact disc can still be challenging due to the complexity of the assay itself. Research groups from around the world have created various units of fluid-handling technologies that can be combined into a fully-automated assay. These can include more complex techniques such as valves and pumps that are actuated, or “turned on”, by heat, magnets, laser, specific spin profiles, and more. Detection techniques using optical and electrochemical methods, which are crucial for retrieving results of the assay, have also been optimized and reported.

The diagnostic and research potentials of centrifugal microfluidic platforms are still being explored. In the future, assays on compact discs, or Lab-on-Disc systems, can potentially be custom-built using portable rapid prototyping systems to bring research and diagnostic power to new and remote locations.

Publication

[Lab-on-a-CD: A Fully Integrated Molecular Diagnostic System.](#)

Kong LX, Perebikovsky A, Moebius J, Kulinsky L, Madou M.

J Lab Autom. 2015 Jun 16