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Cheap, rapid DNA/RNA diagnostics via amplified DNA nanoballs

Researchers at Stanford, Yale, Rutgers, and the Karolinska Institute (Sweden) have developed a rapid and cheap method to detect genetic material from pathogenic infections (viral, bacterial, etc.) using electrical impedance measurement of amplified DNA nanoballs.

Widely available diagnostic tests for infectious diseases are essential for managing public health. Optimal scalable diagnostic tests are fast, cheap, highly accurate, and can be completed at home. While polymerase chain reaction (PCR) tests are the gold standard for accuracy, they are slow, expensive, and must be performed in specialized laboratory facilities. Antigen-detection tests are lower in cost and portable, but often sacrifice accuracy. Tests for genetic material based on loop-mediated isothermal amplification (LAMP) have gained traction due to their lower cost and faster speed, but comparable accuracy to PCR tests. LAMP is a method of DNA detection that enables rapid amplification of a specific gene at constant temperature. Negating the need for variable temperatures, as is required for PCR tests, increases the scalability and application of LAMP tests to higher volumes and lower resource facilities. However, LAMP amplification has been typically paired with fluorescence based or colorimetric readouts, which requires costly detection instrumentation, making the application to ultra-cheap, disposable, and/or widespread at home tests challenging.

This technology uses a similar amplification strategy to LAMP, but instead of colorimetric detection, relies on an electrical impedance measurement as the detection output. This is achieved by adding a compaction component to DNA amplification which folds the amplified DNA into micron-sized nanoballs. The presence of these nanoballs can then be directly detected by changes in impedance when the nanoballs flow through a microfluidic channel. The ease of detection for electrical signals along with the high accuracy of DNA amplification enables the

technology to be applied to cheap, fast, and portable devices for high accuracy diagnostic tests for infectious diseases.

Stage of Development: Prototype

Applications

- Infectious disease diagnostic testing
- At home diagnostic tests

Advantages

- Reaction occurs at **constant temperature** (as opposed to PCR which requires thermocycling)
- **Fast detection** (~15-30 mins)
- **Cheaper cost per sample** compared to PCR, antigen, colorimetric LAMP, etc.
- **High accuracy** (comparable with PCR tests)
- Test **compatible with saliva** in addition to swab-based sample collection (compared to colorimetric tests in which saliva often interferes)
- Portable and compatible with **at home use**

Innovators

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