

US Patent No. 10,724,091

SD# 13252

Technology Readiness Level: 5

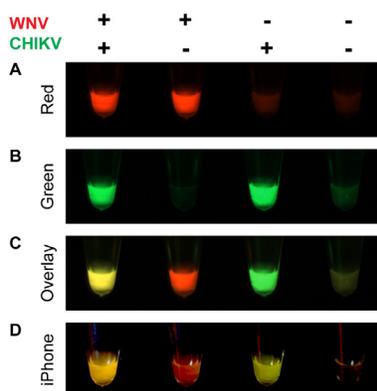
Key elements demonstrated in relevant environments

Sandia's QUASR modification to LAMP helps satisfy the requirements for a simple, robust, and inexpensive point-of-care deployed diagnostic device

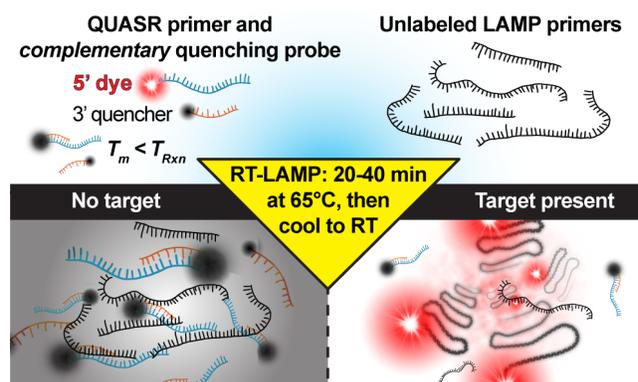
Rapid changes in how the world must react to pandemics has led to an unprecedented effort to develop rapid, easy to interpret point-of-care tests that meet the World Health Organization (WHO) standards. To address this critical need, Sandia National Laboratories developed QUASR (Quenching of Unincorporated Amplification Signal Reporters), a technique to significantly enhance the favorable characteristics of LAMP (Loop-mediated Isothermal Amplification). Combining these capabilities enables SmartLAMP, a smartphone-based deployable diagnostic device to create a simple, inexpensive, and robust system to quickly assess large and potentially dangerous public health situations.

Technology Summary

The basics of Sandia's diagnostic technology is founded on LAMP, a primer-based amplification of DNA/RNA targets. LAMP is one of several isothermal techniques with numerous desirable characteristics and benefits, such as fast response (5-30 min), robust and simple design, high sensitivity, low capital cost, and low power requirements. It can also work with minimal to no sample pretreatment, which is ideal for deployed diagnostics. As a PCR alternative, LAMP has existed for over a decade, yet never became mainstream due to the potential for false positives and lack of multiplexing. Sandia has overcome these issues by incorporating its unique and novel approach to a primer design called QUASR. QUASR significantly brightens the endpoint signal in a closed-tube detection LAMP assay, allowing for a visual difference between positive and negative results that can be discerned and documented with simple equipment like a digital camera, smartphone, or even with the naked eye using a colored filter.



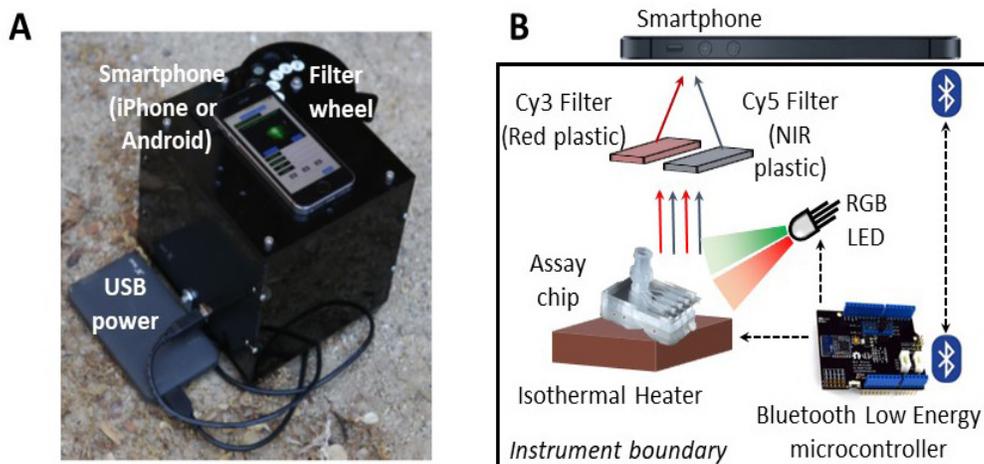
Fluorescence images of 2-color QUASR reactions. Images A and B were taken with a compact CCD camera with traditional fluorescence filters. Image D was taken with an iPhone 6 using a handheld blue LED flashlight for illumination, and an amber-colored plastic film as a filter.



The working principle of the QUASR method, illustrating incorporation of a bright fluorescent tag into amplicons, only in the presence of the specific target, with complete quenching of fluorescence if no target is present.

SmartLAMP: Smartphone instrument for QUASR LAMP

Sandia's QUASR modification to LAMP helps satisfy the requirements for a simple, robust, and inexpensive point-of-care deployed diagnostic device. SmartLAMP is a handheld box that contains a heater, optics, and Bluetooth enabled microcontroller compatible with iPhone and Android phones. The smart phone CCD camera is sensitive enough to quantify the QUASR modified LAMP signals, while the phone application controls the heater, timing, fluorescence image acquisition, and scoring for both real-time or endpoint measurements. The device accepts inexpensive consumables such as PCR tubes and microwells. The prototype is shown with an iPhone giving real-time results.



TECHNICAL BENEFITS

- Massively reduced cost compared to currently testing equipment
- Faster and more accurate testing of human samples—results within 30 minutes
- User-friendly—no need for expensive equipment and technical training
- Eliminates need for lab preparation of biological samples and refrigeration
- Device can be adapted to detect other human or animal pathogens
- Distinguishes current and future SARS-CoV-2 variants and pandemics

INDUSTRIES & APPLICATIONS

- Limited-resource clinics
- Areas with minimally trained medical professional and limited medical facilities
- Any area that needs to detect human or animal pathogens

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