"Coffee Ring" Diagnostic for Point-of-Care Biomarker Detection

VANDERBILT UNIVERSITY
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Bright minds at Vanderbilt University have unveiled a breakthrough technology that could bring sophisticated biomarker diagnostics to the developing world. The point-of-care diagnostic is designed to be used in the field; no specialized equipment, expertise, or white lab coats are required. The diagnostic is based upon the ingenous observation that evaporating liquid droplets leave behind a characteristic ring pattern, which may be familiar to our readers in the form of a coffee-ring stain.

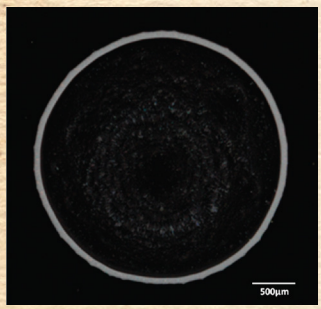


Figure 1. Photograph of the characteristic "coffee ring" particle deposition pattern after evaporation of a 3 µL drop containing 10^6 1 mm white latex particles. The drop has a diameter of approximately 3 mm.

How does this diagnostic work? Consider a liquid sample, such as a drop of blood from a person infected with the malaria parasite. Within that sample are proteins from the malaria parasite. If we place a drop of our sample on a hard surface and let it evaporate, proteins in the solution would preferentially be deposited around the edge of the liquid droplet border as the liquid flows outward during evaporation (akin to the coffee-ring). This diagnostic works by interrupting the outward flow of the malaria protein, or another biomarker of choice, in an evaporating drop. First, one selectively captures the biomarker of interest with targeted magnetic particles, then with the application of a simple magnet, the malaria protein is pulled to the middle of the drop. In this way, the diagnostic concentrates the biomarker internal to the ring pattern. Detection of the biomarker is then determined by a visual assessment of the dispersion pattern of the magnetic particles, or by color coding of the biomarker and a control particle, as seen at right.

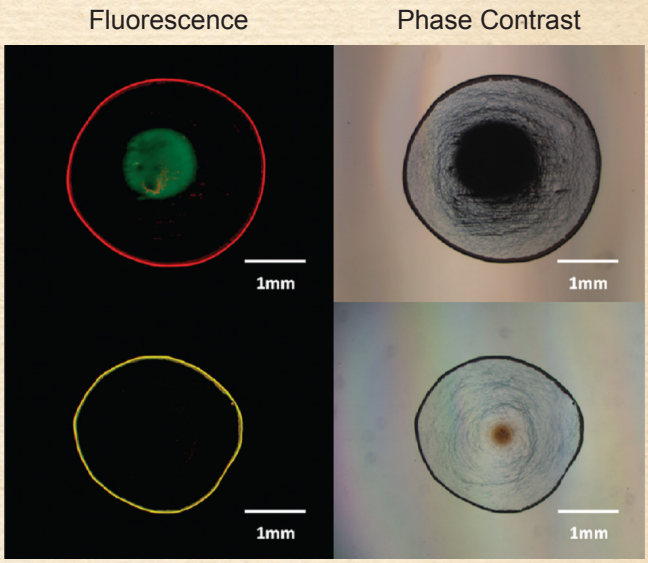
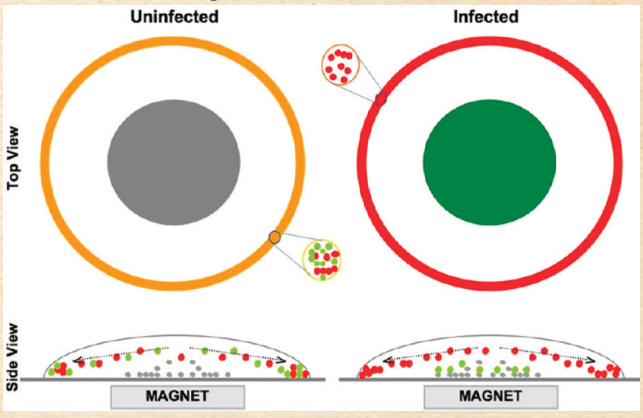


Figure 2. Fluorescence and phase images of particle deposition patterns with a malaria biomarker target (top row) and a control (bottom row). Fluorescence images show the change in color triggered by the presence of biomarker (1.74 mM) from a red ring/green center to a yellow ring without biomarker. Phase images show that magnetic particles are concentrated in the drop center. The center spot in the positive phase contrast image (upper right) consists of both iron oxide and green polystyrene particles resulting in a larger mass spot than the corresponding negative image (lower right).

Schematic demonstrating assay principle shown in fluorescence images above



Intellectual Property Status: A U.S. Patent Application has been filed.

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