ON-CHIP OPTICAL MICROSYSTEM FOR *PLASMODIUM FALCIPARUM* MALARIA DETECTION

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The limitations in the currently used diagnostic methods pose challenges to effective malaria control and elimination. To overcome this, herein, optical spectrophotometry is explored for the detection and quantification of low-level *Plasmodium falciparum* infections. Specifically, we characterize the optical spectra of healthy and infected samples and design, simulate, and fabricate an on-chip optical detection microsystem.

For a preliminary characterization of samples, a 200 W Halogen source directed light onto the sample and the subsequent transmitted or reflected light was detected on a top-bench spectrophotometer. The fabricated CMOS microsystem features a sophisticated array of 16 n+/p- substrate silicon junction photodiodes functioning as photodetectors, coupled with 16 current-to-frequency converters, and was tested with healthy and *P. falciparum*-infected red blood cells (RBCs).

The results indicate that the absorbance and reflectance spectra of the samples in the 400 – 800 nm range can be mimicked by a set of 16 discrete wavelengths. This facilitates the detection (when integrated into a diagnostic device), allows the detection of low level parasitaemia (12 parasites/µL of RBCs) and potentially disease quantification and stage differentiation. Additionally, the designed microsystem was validated through transmittance detection of healthy RBCs and infected samples of 12, 25 and 50 parasites/µL.

Overall, our study demonstrated that the sensitivity of spectrophotometry is competitive to the one of the gold standard diagnostic methods, affirming its potential for malaria diagnosis. Furthermore, the incorporation of these technologies into an affordable and rapid diagnostic device addresses the escalating clinical demands for improved malaria control and elimination.