Tmek: the quantitative rapid diagnostic test for malaria

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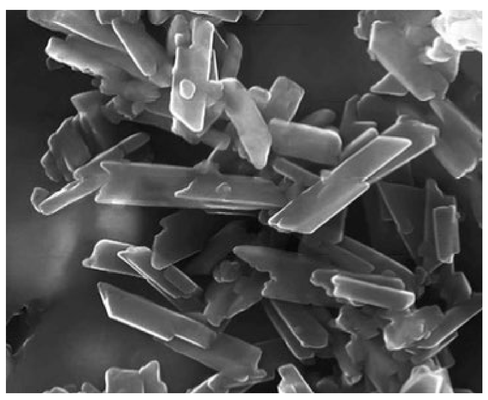
Here we present an innovative platform suitable to magnetically separate infected Red Blood cells (i-RBCs) from healthy ones. It is based on the peculiar paramagnetic behavior of i-RBC with respect to other corpuscles and blood components, thus allowing for a magnetophoretic separation of infected cells in a high magnetic field gradient and concentration on a chip with microfabricated Ni magnetic pillars. The magnetic chip is placed face-down, so that magnetic attraction towards the nickel pillars opposes the gravity. In this configuration, i-RBCs are attracted upwards, towards the micropillars, while non-infected erythrocytes and other corpuscles sediment on the glass substrate. Tests performed in July 2021, allowed us to get proper calibration curves on rings at 18 hours post RBC invasion and stage IV gametocytes, assessing the corresponding LODs. In addition, the single infected cell and fingerprints of the infection stage have been identified. This aspect could truly be a relevant and disruptive innovation for TMek system as it opens the door towards a new malaria diagnostic era based on digital data.

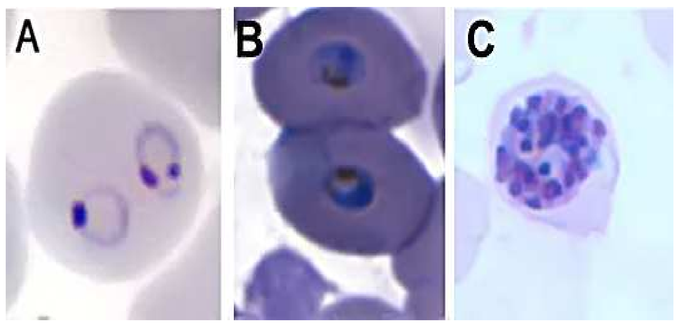
PROBLEM

- Malaria is a parasitic disease caused by Plasmodium and transmitted through female mosquito bites.
- 229 million new cases and 409000 deaths in 2019 [1].
- 93% of deaths in Africa and 70% of children under 5 years [1].
- World malaria community is highly demanding for digital, good quality and local data [2].

Hemozoin crystals

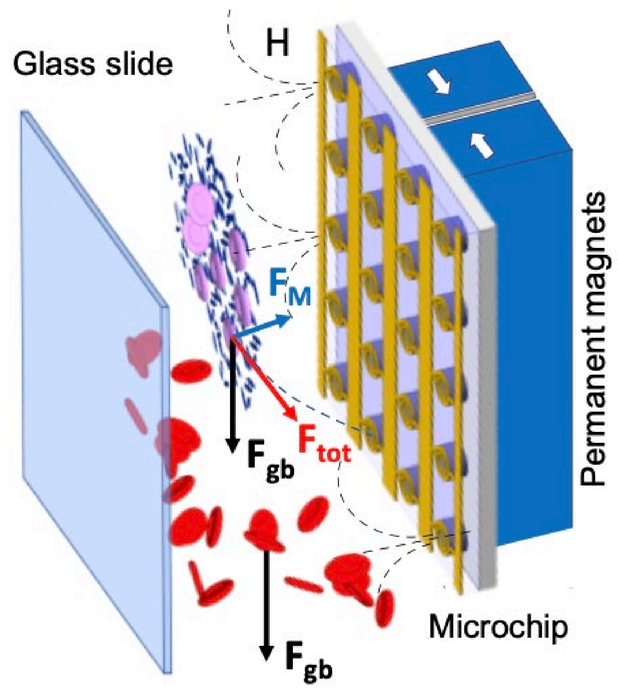


Infected red blood cells (i-RBCs)



SOLUTION

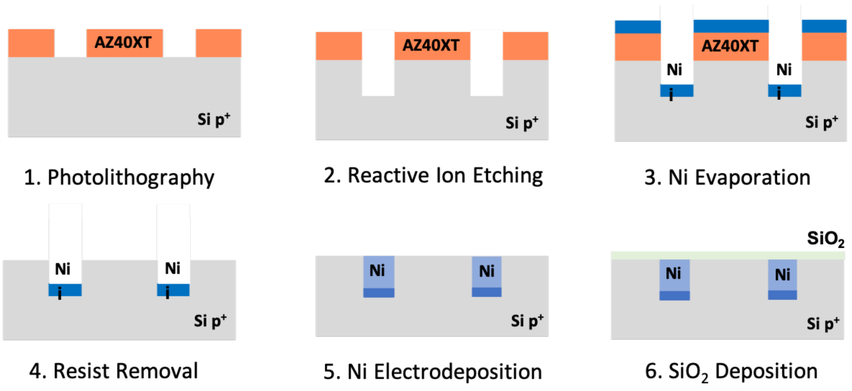
- Specific magnetic attraction of hemozoin and infected red blood cells
- Quantification through an impedance variation detection

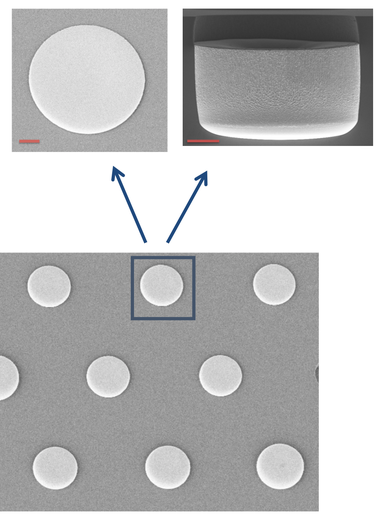


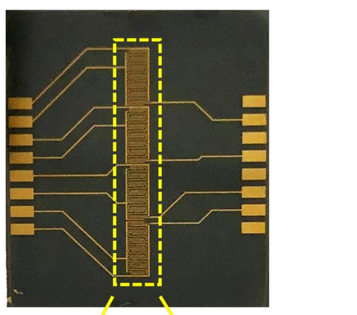
RAPID · PANPLASMODIC · HIGH SENSITIVITY · AUTOMATIC · SINGLE DROPLET ON-CHIP · DIGITAL RESULT

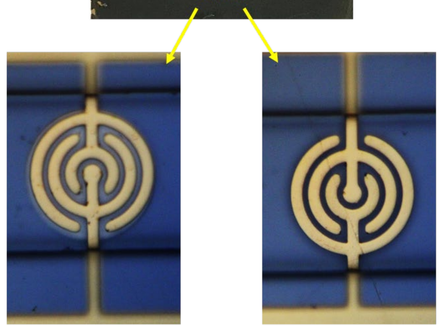
CHIP LAYOUT AND DEVICE FABRICATION

Ni array micro-fabricated process





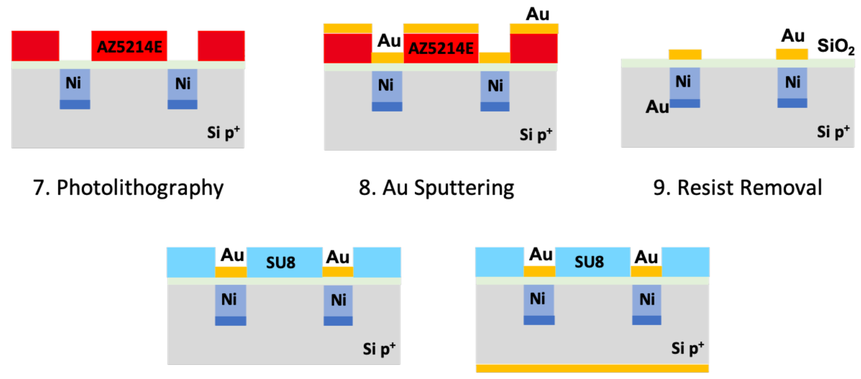




MEASURE ELECTRODE

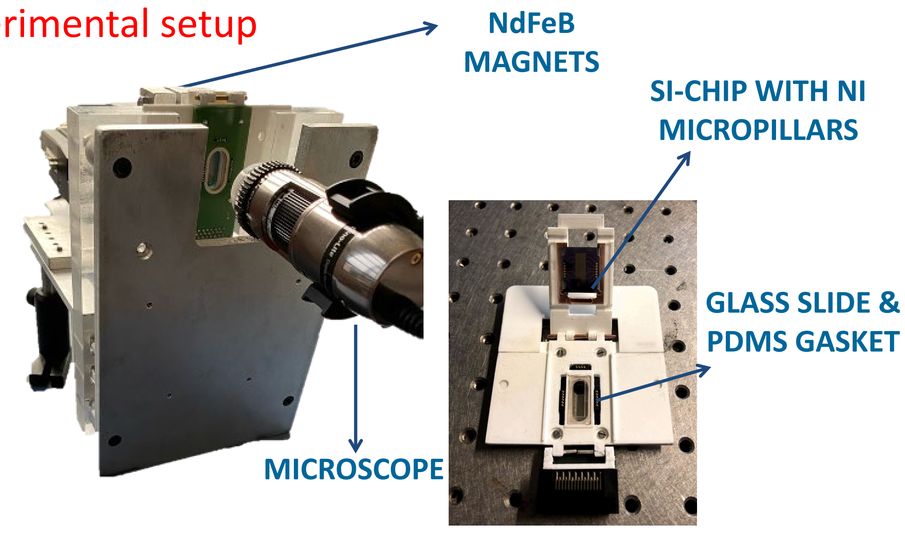
REFERENCE ELECTRODE

Electrodes micro-fabricated process

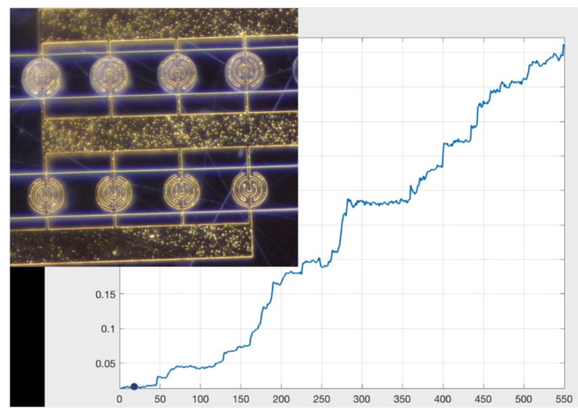


RESULTS

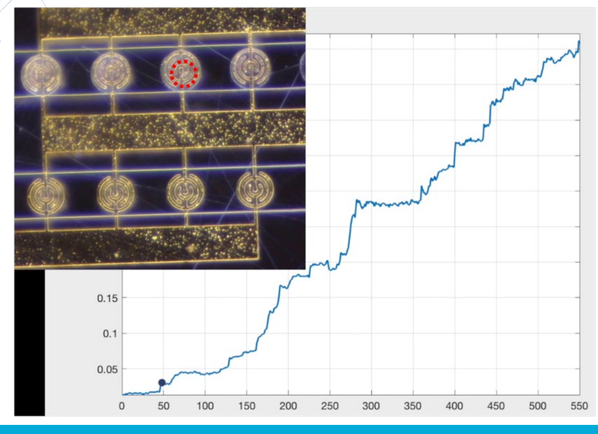
Experimental setup



Single cell counting



Sensing area, made of 4 measurement and 4 reference electrodes, at initial time without any particle captured on top



Instantaneous jump due to i-RBC capture on top of the electrode

References / contact information

[1] WHO 2020. *World Malaria Report 2020*, volume 73. 1997
[2] Rethinking Malaria in the context of Covid-19 Webinar

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