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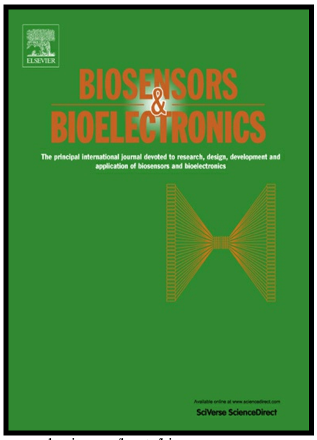


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# A Highly Sensitive Self Assembled Monolayer Modified Copper doped Zinc Oxide Nanofiber Interface for detection of Plasmodium falciparum Histidine-Rich Protein-2: Targeted towards rapid, early diagnosis of Malaria

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## Abstract

Rapid, ultrasensitive diagnostic/triaging kits for early detection of malarial parasites are critical for prevention of malarial epidemic, especially in developing and tropical countries. Unlike traditional microscopic diagnosis, these kits rely on the detection of antigens specific to malarial parasites. One such antigen which is routinely used in these diagnostic kits is Histidine-rich protein-2 ; a protein synthesized and released into the blood stream by the parasite Plasmodium falciparum. In this paper, we demonstrate an ultrasensitive nanobiosensor detection platform for Histidine-rich protein-2 having a limit of detection of attogram/ml. This nanobiosensor platform comprises of Mercaptopropylphosphonic acid functionalized copper doped zinc oxide nanofibers synthesized by electrospinning technique. Ultrasensitivity of attogram/ml can be attributed to the complimentary effects of Mercaptopropylphosphonic acid and copper doping in zinc oxide. Mercaptopropylphosphonic acid enhances the functional groups required for immobilizing antibody. Copper doping in zinc oxide not only increases the conductivity of the nanofibers but also pre-concentrates the target analyte onto the Mercaptopropylphosphonic acid treated nanofiber surface due to inherent electric field generated at the copper/zinc oxide heterojunction interface. The impedimetric detection response of copper-doped Zinc oxide nanofiber modified electrode shows excellent sensitivity (28.5 KΩ/(gm/ml)/$cm^2$ ) in the detection ranges of 10ag/ml-10μg/ml, and a detection limit of 6 attogram/ml. In addition, the proposed biosensor is highly selective to targeted HRP2 protein with a relative standard deviation of 1.9% in the presence of various interference of nonspecific molecules. To the best of our knowledge, this biosensor shows the lowest detection limit of malarial parasites reported in the literature spanning different nanomaterials and different detection mechanisms. Since the nanobiosensor platform is based on immunoassay technique, with a little modification, it can be extended for developing point-of-care diagnostic devices for several biomarkers of importance.