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**A mobilephone imaging-based fluorescent mercury sensor with minimal user intervention and high sensitivity**

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Deployment worldwide of point-of-care (POC) diagnostic devices has been limited due to operational complications caused by multiple steps with user interventions that the expertise is necessary. To enable the general public to adopt POC technology, minimization of user intervention with high sensing accuracy to operate POC device is required. Here we report a novel device for control of biochemical detection with passive regulation of reaction incubation time. This device provides tunable reaction incubation time according to its dimension combinations as well as immediate sample removal and washing in the way of minimizing the user intervention. We tested the application of the device on smartphone imaging-based fluorescent microscopy by detecting mercury ion ( $\text{Hg}^{2+}$ ) with Thymine mismatch DNA probes. Since the device was designed to be adherable to arbitrary substrate, we utilized nano-structured plastic substrate with enhanced fluorescent signal. Additionally, dual wavelength fluorescent detection was used to obtain high detection accuracy. With decreased user intervention, overall detection performances of this novel POC device in comparison with conventional method will be discussed in detail.