ABSTRACT SUBMISSION

Title: A miniaturized and low-cost sub-nanosecond fluorescence lifetime detector based on and array of CMOS SPAD detectors

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Text Abstract

Optical biosensors are probably the most popular in bioanalysis due to their selectivity and sensitivity. Among them, fluorescence lifetime detection is expected to enhance the reliability of biomolecular interaction assays as it is an intrinsic determination of the fluorescence. Fluorescence lifetime can be used for pathogen detection or in DNA assays, which is of utmost importance primarily for health and safety reasons in the food industry, water and environment quality control and clinical diagnosis.

Lifetime measurements can be done by time-correlated single-photon counting (TCSPC), implemented by repeatedly stimulating a fluorophore and recording the time until the first emitted photon is detected by a sensor. It is usually performed with expensive and bulky picosecond lasers to excite the sample, photomultiplier tubes or avalanche photodiodes to detect the emitted light, and photon counting modules.

Our device is operated in TCSPC with a conventional and low cost laser diode, which is driven by off-the-shelf electronics with sub-nanosecond fall times, a CMOS chip featuring a linear array of ultra-sensitive avalanche photodiodes (APD) working in Geiger mode, a microfluidic channel on top of the CMOS chip (Polydimethylsiloxane), and a low cost FPGA processing the data coming from the detector. An optical filter is not needed because we control accurately the switch-off time of the laser pulse just a few picoseconds before the detector is habilitated for sensing. At the same time, the proximity of the sample and the APD sensors makes unnecessary the use of lenses.

We have developed a lifetime fluorescence detection system, which is simple, miniaturized and cost effective. This new technology is being developed to build a PoC (Point of Care) device for molecular diagnosis. The system was tested with several concentrations of fluorescent quantum dots (QDOT 605 from Life Technologies), having a lifetime of 35ns. Measurement times were only 15 seconds.

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Approve to publish	Yes
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