CHARACTERIZATION OF SILICON PHOTODIODES FOR DIFFUSE REFLECTANCE SIGNAL EXTRACTION

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ABSTRACT: Gastrointestinal (GI) cancer is one of most common cause of cancer-related death over the world. Its detection at its earliest stage is crucial to increase the patient survival chances (1). Optical signals extraction and analysis, specifically diffuse reflectance and intrinsic fluorescence, may improve the ability to detect GI dysplasia, once some morphological and biochemical changes on the tissues (related with early cancer progression) can modify these signals' shape and intensity (2, 3). The project under this paper aims to develop a chip sized spectroscopy microsystem for the early detection of GI cancer. This paper presents the characterization of silicon photodiodes (n+/p-epilayer type) fabricated in a standard 0.7 µm CMOS process, with different dimensions. The main goal is to conclude which photodiode must be fabricated for the microsystem implementation, taking into account its capacity to extract the signals in the relevant spectral band (350 nm – 750 nm), not comprising the microsystem dimensions. Figure 1(a) allows concluding that the suitable photodiodes for the detection of those spectroscopic signals are the 125 × 125 µm^2 or 100 × 100 µm^2 active area photodiodes, once their quantum efficiency varies between 20% and 55%, approximately, above 450 nm. In spite of the low photodiodes quantum efficiency (lower than 20%) below 450 nm, the viability of using the 100 × 100 µm^2 photodiode to extract the diffuse reflectance signal, between 350 nm and 750 nm, was proven using a test phantom, representative of a GI tissue – Figure 1(b).

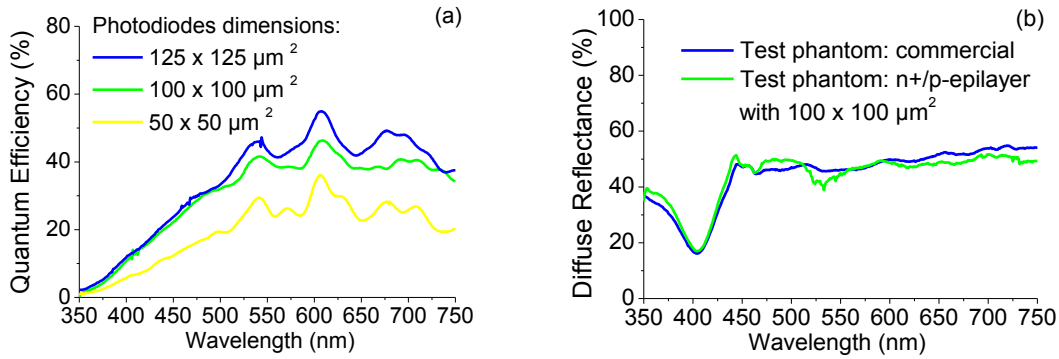

Figure 1. (a) Measured spectral response of the fabricated photodiodes; **(b)** Diffuse reflectance spectra for a test phantom using a calibrated commercial photodiode and the fabricated n+/p-epilayer with 100 × 100 µm^2. A liquid homogeneous phantom was used, with hemoglobin concentration of 0.5 mg/mL and polystyrene 1 µm beads mass concentration of 0.25%.

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