A fluorescence imaging device with a portable system for detection of nitric oxide

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The discovery of nitric oxide (NO) as a signaling molecule in the cardiovascular system has been contributed to extensive medical researches [1]. To be clarified the mechanisms of NO inside the body related deceases such as a stroke, many studies developed methods for detection NO in animals [2]. However, conventional methods are difficult to detect NO in animals related with behavior.

Our aim is innovating a miniature implantable CMOS imaging device with a portable system to observe NO in an animal body with minimally invasive methods. In this study, we developed the imaging device and evaluated functions of the imaging device.

Block diagram of the imaging system which includes an imaging device and a microcontroller for an interface module is shown in Fig.1a. The imaging device was constituted an image sensor (30x90 pixels), blue LEDs (λ=470 nm) for excitation light and an optical filter (high pass λ >500 nm) as shown in Fig.1b. The device was coated with parylene for water–proof and biocompatibility. The interface module, shown in Fig.1c, connected to a PC with a USB connection to downsize the portable system.

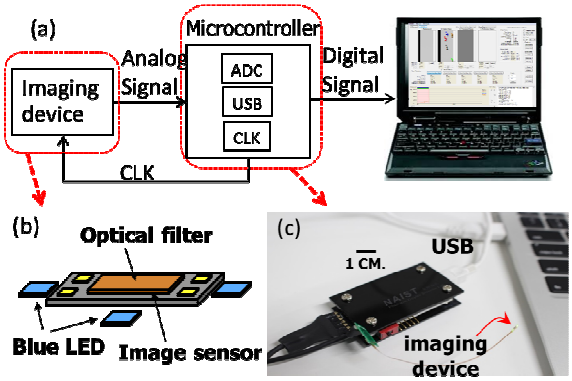

Fig. 1 (a) Block diagram for interfacing with an image sensor and a via USB port. (b) Structure of the fluorescence imaging device. (c) An interface module with a USB connection.

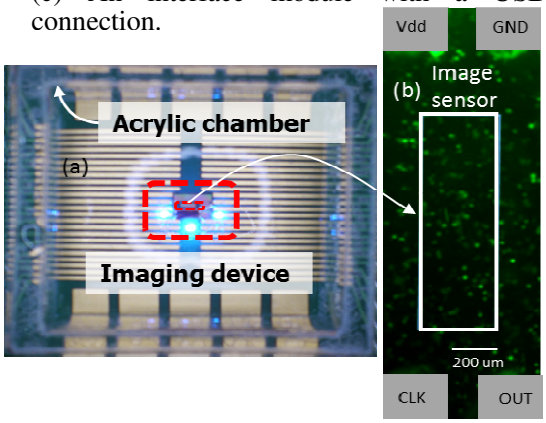

Fig. 2 (a) A photograph of the acrylic chamber and the imaging device. (b) Florescence image of NO signal from endothelial cells

For detecting NO signal, we stained endothelial cells with DAF-FM DA (Sigma-Aldrich Co., Ex/Em 500/515 nm) as a fluorescence probe. After staining, we cultured the cells on an acrylic chamber that was included the imaging device and measured fluorescence. Fig.2b shows fluorescence from the cells on the imaging device captured by a conventional microscope. The cells fluoresced brightly on the sensor surface. For the next step, we will measure NO production in the cells using our fluorescence imaging device.

[1] S. Ruth, Circulation, 98. 2365–2366 (1998)
[2]A. Nicole *et al.*, Circ Res, 110(5), 727-738 (2012).