

【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Engineering I)



Title of Project : Invention of Ion-Fluorescence Multi-Modal Image Sensor System For Elucidation of Cell Functions

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Research Area : Semiconducting material, Device, Integrated circuit chip

Keyword : Sensing, Integrated Multi-biosensor, Image sensor

【Purpose and Background of the Research】

A multi-modal sensor which can detect simultaneously a neurotransmitter, light, and fluorescence on a same pixel is realized, and the multi-modal bio-image sensor which can discriminate from a role and work of the ion channel which exists in a cell is fabricated.

The multi-modal bio-image sensors are fabricated with super-high resolution image sensor which is 1 micron or less, and set primary neuronal cells of hippocampus and the brain slice of a mouse on this bio-image sensor directly. A fluorescence, which indicates intracellular ion information, and chemical signal, which was emitted from an ion channel and neurotransmitter (acetylcholine, glutamic acid, ATP), is observed by the proposed system simultaneously as a 2 dimensional images (video). Corroboration work with the biochemistry field researchers will go on by using the novel bio-image sensor, which can be observed movements of the ion on the inside and outside through a cell to elucidate of cell functions.

A motion of the ion of the inside and outside of a cell which is impossible by the conventional optical microscope without label. The purpose of this propose is realization of the imaging system which can be visualized ion movements through the ion channel in real time without label.

【Research Methods】

The investigation has 2 parts, one is development of novel device and another is to apply the device in bio-medical fields. There are three issues which should be solved to realize novel bio-image sensor. (a) Development of Ion image sensor special fabrication process with 0.18micron meter rule. (b) Development of special pixel configuration for sub-micron pixel pitch image sensor. (c) Development of fabrication process to keep ion sensitivity on a sub-micron ion sensor. These issues are developed with a corroborator in LSI manufactory. The sensor of the 20-micron pitch which already developed is used until the multi-modal image sensor of a submicron pitch is realized.

【Expected Research Achievements and Scientific Significance】

We have been invented and developed a special image sensor. The image sensor has a special sensor devises, which is able to catch several information on one sensing area, and the image sensor capable to take videos that indicate different information (fluorescence, chemical concentrations, geometry, light intensity, place....). These relationships of these information is reliable because these information are taken by one sensor. A flame rate will be decrease less than 10msec, and it might be possible to take an image of release of neurotransmitter from synapses. The sensor is very original and there is no related work in a world. If the image sensor is realized, the movement of ion through the ion channel will be clear as a video, and it will became a strong tool to elucidation of cell functions. I believe this novel image sensor innovate an environment of medical diagnosis and medicine manufacture.

【Publications Relevant to the Project】

- Multimodal bio-image sensor for real-time proton and fluorescence imaging, Hirokazu Nakazawa, Makoto Ishida, Kazuaki Sawada, Sensors and Actuators B: Chemical, in press.
- A Fused pH and Fluorescence Sensor Using the Same Sensing Area, Hirokazu Nakazawa, Hiroyasu Ishii, Makoto Ishida, and Kazuaki Sawada, Appl.Phys.Express, No.3, 047001-3 (2010)

【Term of Project】 FY2012-2016

【Budget Allocation】 134,200 Thousand Yen

【Homepage Address and Other Contact Information】

<http://int.ee.tut.ac.jp/icg/>