Introduction

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We use CMOS Image Sensor (CIS) instead of Charge-Coupled Device (CCD) because CIS has low power consumption and high readout speeds than CCD on smartphone and digital camera [1]. However, CIS has low Quantum Efficiency (QE) and crosstalk (X-talk) ratio than CCD [2]. Therefore, we should increase QE of CIS. Usually, QE was varied by CIS structure. Several structure already introduced [3] [4] [5].

Not only structure, but also QE vary among the distance from center of a camera chip. At the corner of a chip, the light propagate obliquely [6]. Therefore, the light was detected little than the center of a chip because of scattering. Different QE detection on the same chip causes irregular brightness or resolution in an image. One solution is to shift the CIS; this change causes the light to spread smoothly to the detection region. However, a shifted CIS still has low QE and high X-talk than normal CIS.

This paper proposes a tilted Deep-Trench-Isolation (DTI) CIS which can increase QE than shifted CIS. The proposed structure optimized by FDTD simulation with varying shifting distance of Micro Lens (ML), Color Filter (CF) and angle of DTI.

[1] Teledyne DALSA Inc https://www.teledynedalsa.com/en/learn/knowledge-center/ccd-vs-cmos/ (accessed Jul 10, 2018).

[2] Alper, G. CCD vs. CMOS, sensitivity in low light improvements with industrial CMOS image sensors and cameras – Adimec https://www.adimec.com/ccd-vs-cmos-sensitivity-in-low-light-improvements-with-industrial-cmos-image-sensors-and-cameras/ (accessed Jul 10, 2018).

[3] Tu, C. N., Yeh, Y. L., Hsing-Chih, L. I. N., Huang, C. C., & Chen, S. S. (2017). U.S. Patent No. 9,818,779. Washington, DC: U.S. Patent and Trademark Office.

[4] Moon, C. R., Lee, D. H., & Cho, S. H. (2012). U.S. Patent No. 8,164,126. Washington, DC: U.S. Patent and Trademark Office.

[5] Agranov, G., Berezin, V., & Tsai, R. H. (2003). Crosstalk and microlens study in a color CMOS image sensor. IEEE Transactions on Electron Devices, 50(1), 4-11.

[6] CMOS sensor CRA https://www.dpreview.com/forums/thread/3819663 (accessed Jul 8, 2018).