トランジスター生誕７５周年記念に際し、IEEE EDS学会からイメージセンサーの開発歴史について特別論文寄稿する機会をいただきました。

P2023_IEEE_EDS_Newsletter_Jan_2023_on_Chronology_of_Silicon_based_Image_Sensor_Development.pdf *pp.18-21 参照*

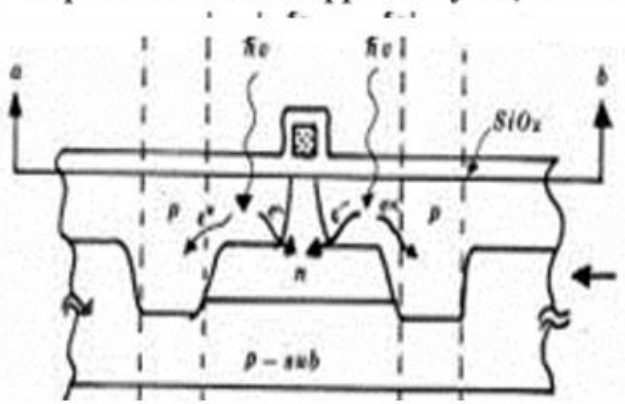
Image Sensorへの応用ではすでに1978年に日本応用物理学会主催の国際会議SSDM1978にて、SONY(萩原)が、あまり詳細な説明はしていませんが、図13で量子変換効率が８０％を、ほぼ直線の傾きで、実現している事を明示しています。

Image Sensorへの応用ではすでに1984年にKODAKも、IEEEの国際会議 IEDM1984 で詳細に図４で量子変換効率８０％実現している事を明示しています。

Image Sensorへの応用ではPNP接合の完全空乏化された埋め込みN層のConduction Band の谷底の電位 Minimum Potential (Vm)は深く逆バイアスされプラスの値になります。Vm＞０　になります。

太陽電池では N 層が順方向バイアスとなり、Vm＜０ になります。しかし多重接合にして、空乏層の幅を広げることが可能であり、変換効率も限りなく理論限界の８０％まで実現可能です。

Proceeding of the 10th Conference on Solid State Devices, Tokyo, 1978;
Japanese Journal of Applied Physics, Volume 18 (1979) Supplement 18-1, pp.335-340



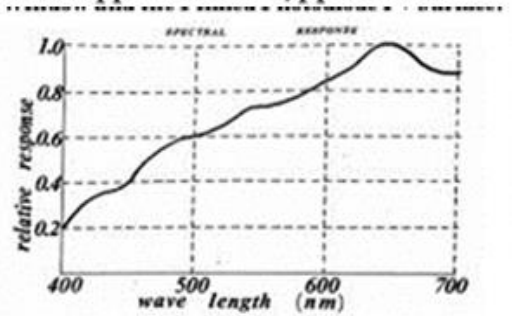


Fig.13 Spectral Response of the Pinned Photodiode with Pinned SiO2 Window and Pinned Surface.

Hagiwara_SSDM1978_Paper_on_Pinned_Buried_Photodiode.pdf

THE PINNED PHOTODIODE FOR AN INTERLINE-TRANSFER CCD IMAGE SENSOR

B. C. Burkey, W. C. Chang, J. Littlehale, T. H. Lee,
T. J. Tredwell, J. P. Lavine, E. A. Trabka

Research Laboratories, Eastman Kodak Company
Rochester, New York 14650

28 — IEDM 84

KODAK used LOCOS isolation which induced serious dark current and crystal defects degrading chip yield.

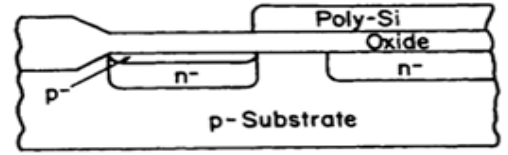


Fig. 1. Image cell schematic.

In this KODAK Pinned Photodiode IEDM1984 Paper, the Quantum Efficiency of 80% has been already achieved !

ABSTRACT

A pinned photodiode has been developed for use in an interline-transfer CCD. This photoelement has excellent blue response and high charge capacity. Both modeling and experimental results will be presented, including process considerations necessary to avoid unwanted barriers at the diode/transfer-gate edge.

CONCLUSION

Both the excellent blue response and high charge capacity of the pinned diode have been demonstrated. The processing of this device requires some care, however, to avoid the formation of potential barriers at the pinned diode/transfer-gate edge. This photoelement is ideal for applications requiring good blue response, large dynamic range, and no image lag. The processing considerations should also apply to the virtual-phase CCD.

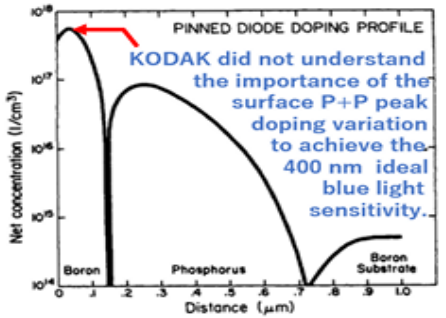


Fig. 2. Pinned diode doping profile.

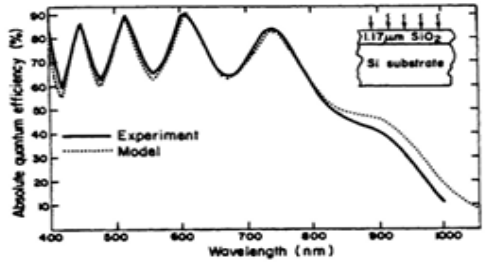


Fig. 4. Pinned diode spectral quantum efficiency. Solid and dotted curves are the experimental and theoretical curves, respectively.

The pinned photodiode for an interline-transfer CCD image sensor | IEEE Conference Publication | IEEE Xplore