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A 380H × 488V CCD Imager with Narrow Channel Transfer Gates

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Longer Wave Length Light (0.5~0.7 μm) has almost 100% QM (η=1) in Silicon.

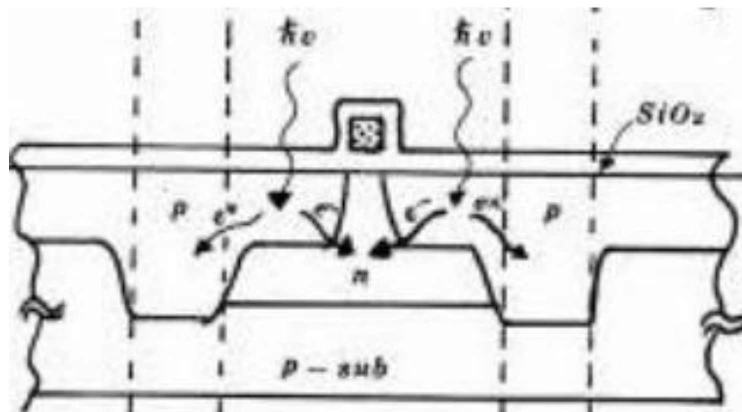

Fig. 2. cross sectional views of the electrode

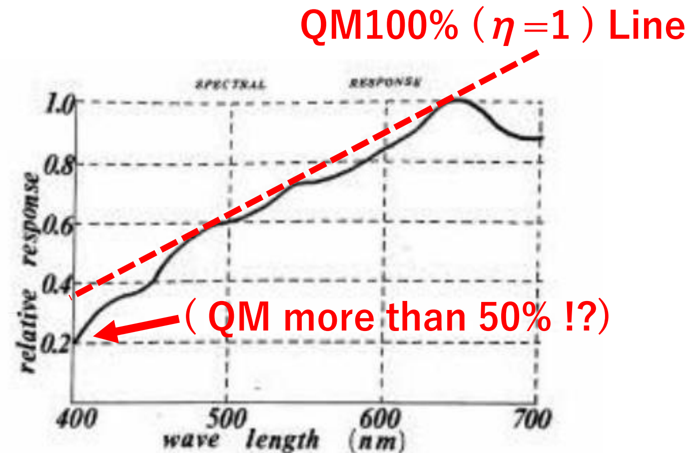

Fig. 13. Spectral Response of the photosensors.

This is the first original PNP Pinned Photodiode developed in 1978 with the excellent short-wave blue light sensitivity.

Hagiwara at Sony invented and formed the adjacent P+ channel stops to pin the P+ surface, using high-energy ion-implantation.

This PNP double junction Pinned Photodiode structure can be used for a solar cell with a very high quantum efficiency.

The plantation mask, boron ions with the dose level of 2×10^{13} cm^{-2} are implanted into the silicon substrate throughout the exposed portions of the thermally grown oxide. This step provides self-aligned channel stops which surround the narrow-channel transfer part of each electrode. The gate oxide thickness is 130 nm throughout the device.

The transfer efficiency of the vertical and horizontal shift registers are more than 99.995% per transfer. And high image resolution of 280 TV lines/p.h. (Horizontal) and 350 TV lines/p.h. (Vertical) have been obtained.

The typical dark current level is less than 3% of the maximum signal level at the room temperature of 20°C. The spectral response of the imager shows that this inherently SiO_2 exposed structure has high enough quantum efficiency at 450 nm wavelength and functions as a color imager with high sensitivity.

The typical dark current level is less than 5 nA/cm^2. For the particular device reported in this paper, the ion implantation dose of the buried channel is taken to be 1.7×10^{12} cm^{-2}.