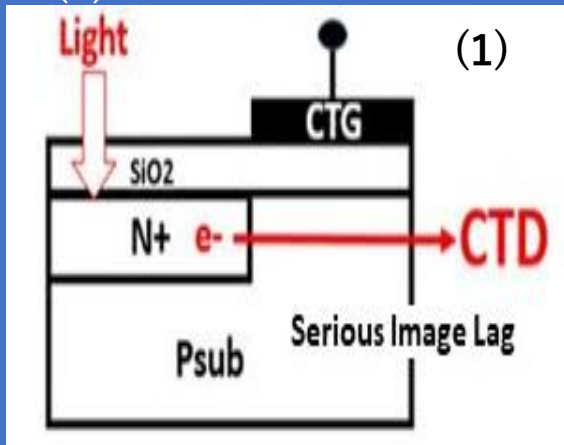


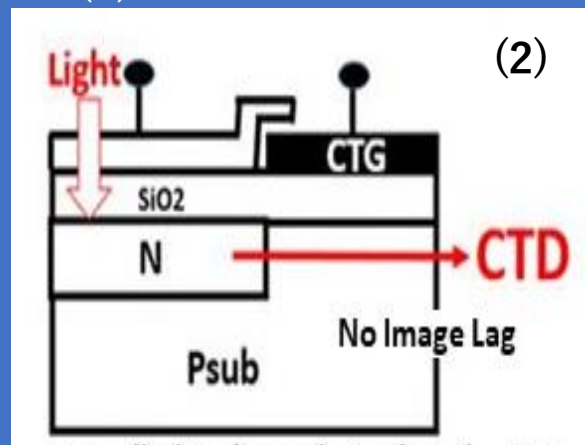
# Story of Pinned Photodiode

(1) Widely used before 1970, the N+P Single Junction Dynamic Photodiode has the N+ Floating Surface type Signal Charge Storage Region causing the serious image lag problem. Besides there is no surface electric field to separate the photo electron and hole pairs generated by the short-wave blue light at the vicinity of the semiconductor surface. The photo electron and hole pairs cannot be separated and eventually they recombine again to become heat. The short-wave blue light sensitivity is not good. This is why the single N+P junction photodiode type conventional low-cost solar cell has the poor quantum efficiency of about 20%.

(1) used before 1970



(2) invented in 1970



(2) Invented by Boyle and Smith in 1970, the CCD/MOS Dynamic Photo Capacitor has the complete charge transfer and no image lag problem but with the poor short-wave blue light sensitivity and serious surface dark current problems.

(3) Invented in 1975 and developed in 1978 by Yoshiaki Hagiwara, the PNP double junction Pinned Photodiode has the completely buried charge storage region with the grounded surface P+ hole accumulation region being pinned and connected directly to the adjacent P+ channel stops formed by the high energy ion implantation technology instead of the LOCOS process technology widely used then. This Pinned Buried Photodiode has an excellent short-wave blue light sensitivity, no surface dark current problem and no image lag problem with complete charge transfer capability.

(3) See JPA 1975-134985 invented by Hagiwara in 1975

