Difference between Buried Photodiode and Pinned Photodiode ?

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Buried Photodiode (BPD) simply means a SiO2 exposed PNP junction type photodiode (PD) with the buried N type layer of charge collection region that collects the signal charge electrons which are isolated from the surface interface.

Depleted Buried Photodiode (DBPD) is designed to have the signal charge collection region deplete out when reset. The signal charge is to be transferred to the adjacent charge transfer device (CTD) thru a charge transfer gate (CTG) with the CCD-like complete charge tranfer operation mode, resulting image lag free picture quality. As DBPD depletes, it becomes desconnected from the readout circuit and if designed properly will drain all signal charge out of the collection region, accomplishing the CCD like complete transfer of charge.

As DBPD is completely depleted of the signal charge, the capacitance of DBPD drops effectively zero, that is, with effectively zero thermal CkT noise, which is proportional to the random thermal behavior of the signal charge that does not exist when forced to move in one diection in the complete transfer of charge.

Pinned Photodiode (PPD) is by necessity a DBPD, but not all DBPD are pinned. PPD must have the pinned window and the pinned surface potential of heavily P+ doped hole accumulation region in order to quench the Si/SiO2 interface trap state Nss (causing 1/f noise from trapping/de-trapping) and the surface fixed positive charge +Qss (causing the surface dark current and white point defects).

With the pinned window and the pinned surface potential, when the PPD is completely depleted of siganl charge, the empty potentail well of the collection region is also pinned to a certain voltage that can be designed properly by adjusting the impurity doping profile of the P+NP junction structure of the PPD.

The first PPD was invented by Hagiwara at Sony in 1975 and is used in ILT CCD Photodiodes (PDs). These same photodiodes (PDs) and the principles behind this complete transfer of charge are used in all CMOS imagers built today.In Japanese Patent 1975-134985　Hagwiara at Sony invented the P+NPNsub junction type Pinned Photodioe (PPD) with the built-in vertical overflow drain (VOD) function. This PPD with VOD is now called as SONY original Hole Accumulation Diode (SONY HAD). In Japanese Patent 1975-127647 Hagiwara also invented the back light illumination (BLI) type Pinned Photodiode(PPD) with the charge transfer gate (CTD)　being used as the MOS capacitor type buffer memory (MOS BM) for Global Shutter Operation (GSO).

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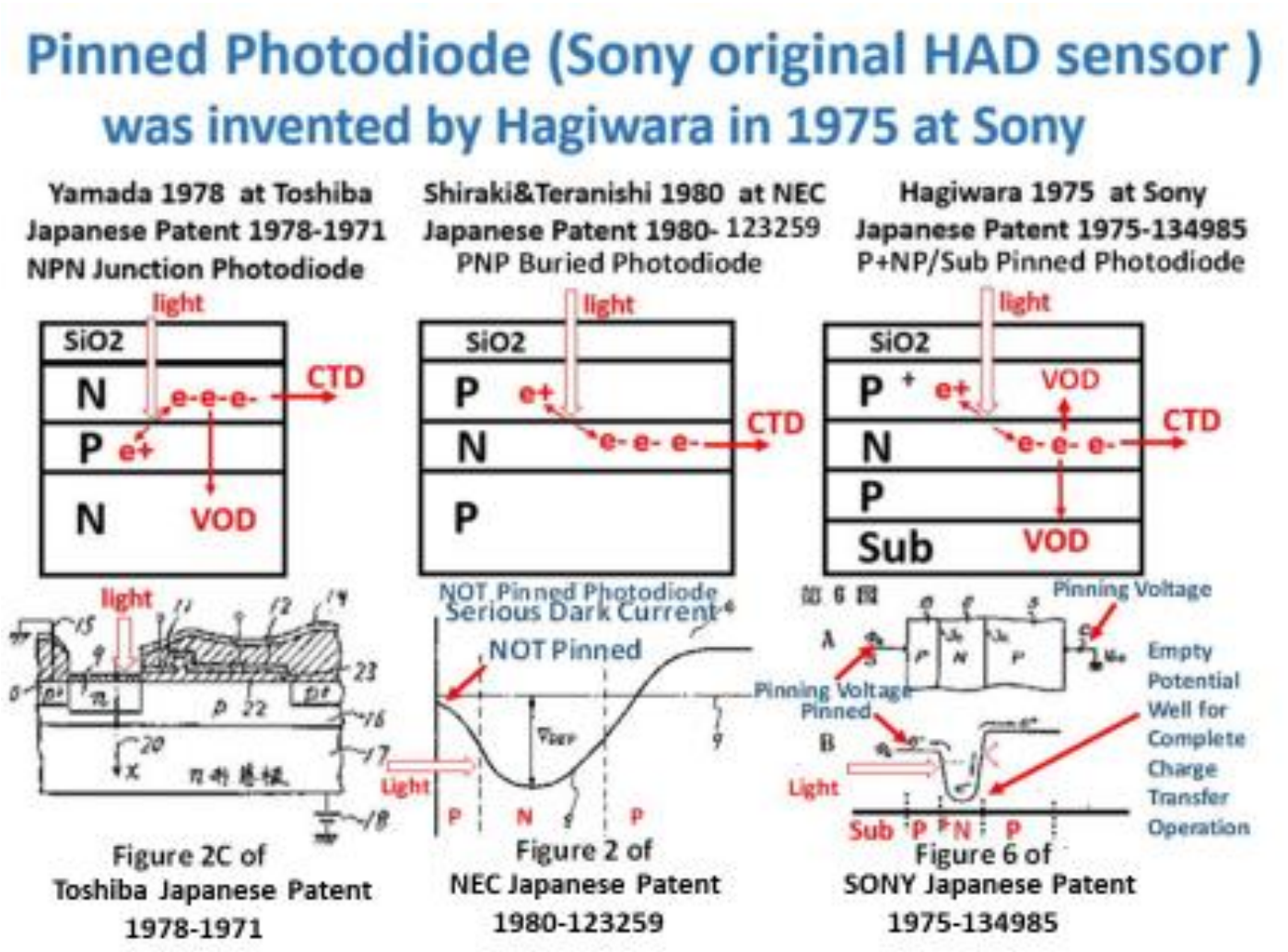

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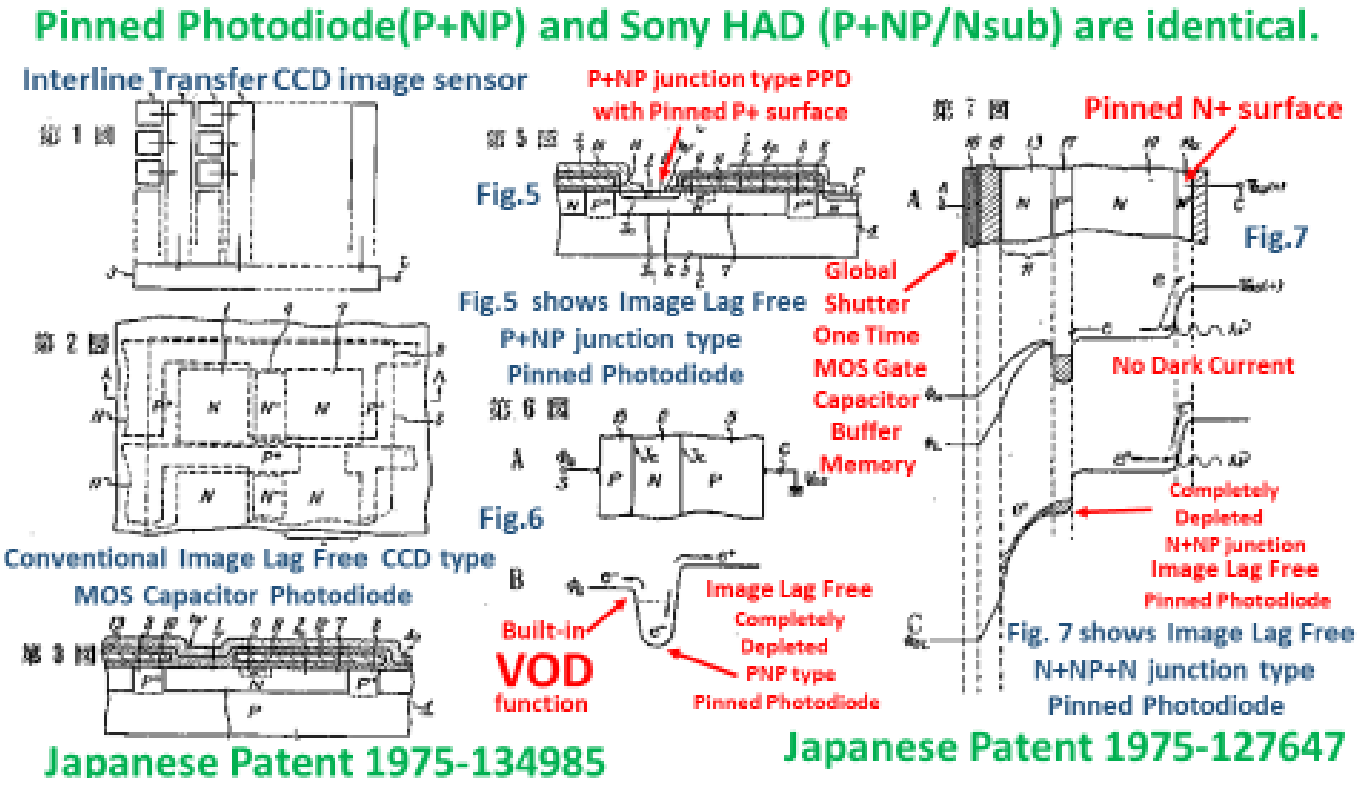

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