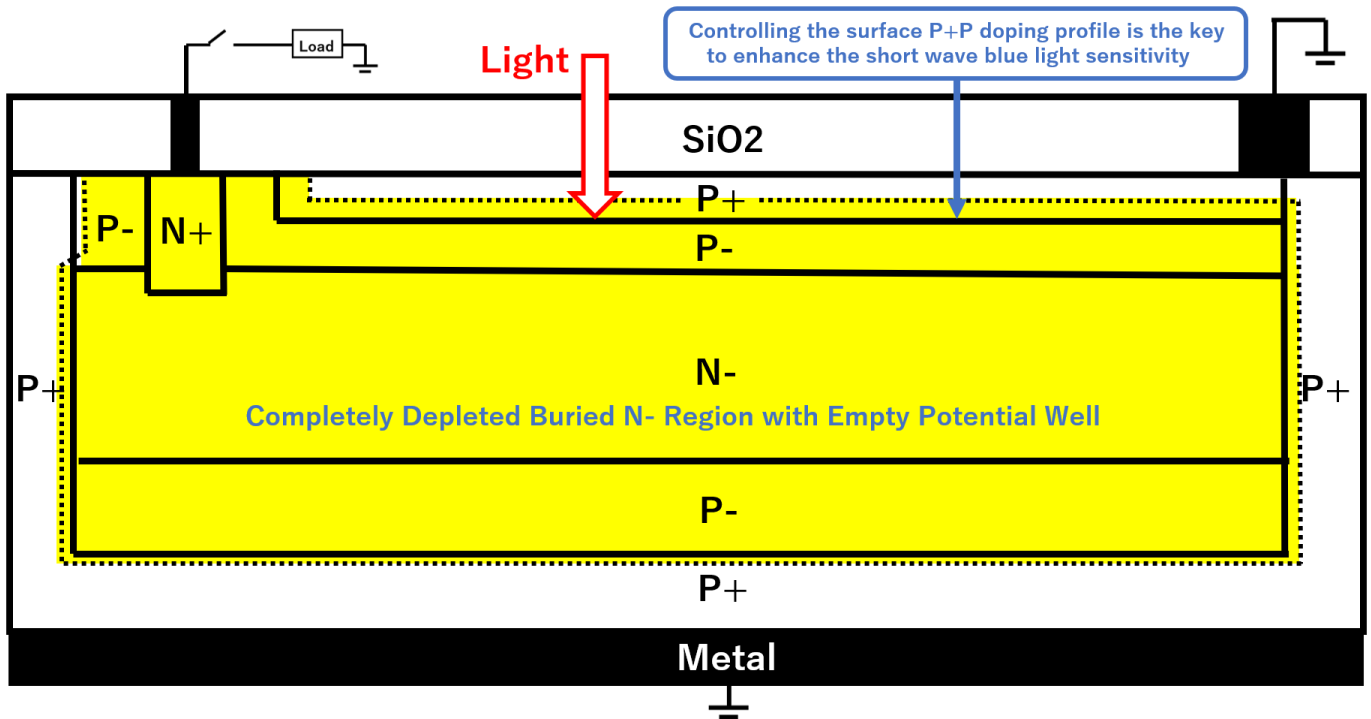


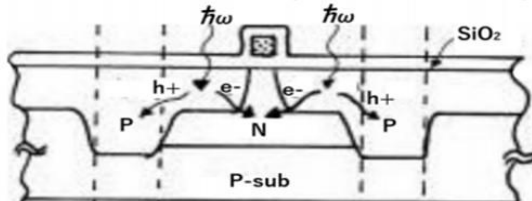
The newly proposed P<sup>+</sup>P-N-P-P<sup>+</sup> junction type Solar Cell may have a higher efficiency.



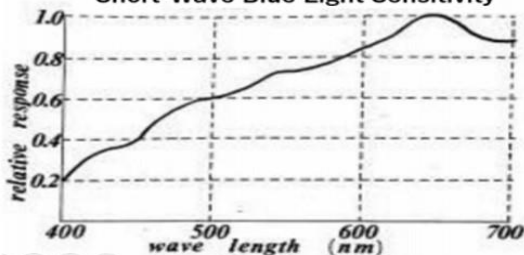
Wide Gap and Tandem Semiconductors were needed for the short-wave high-energy sun-light component to penetrate deep into the semiconductor crystal, where we can form the depletion region with the barrier electric field, which is needed to separate the photo electron and hole pairs. However, the surface P<sup>+</sup>P doping variation by the clever ion implantation technology can also create the surface barrier electric field for the short-wave blue light. This idea was confirmed in 1978 and reported in SSDM1978 by Hagiwara.

SSDM1978 paper on the PNP junction type Pinned Photodiode with the Pinned P<sup>+</sup> surface connected to the adjacent P<sup>+</sup> channel stop:

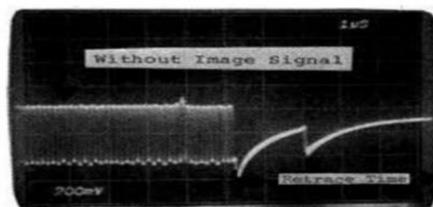
(A) Pinned-Surface and Buried-Storage PNP Photodiode with Adjacent Channel Stops



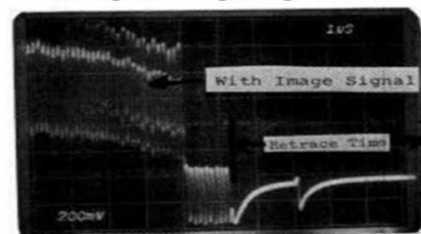
(B) Spectral Response with Very High Short-Wave Blue Light Sensitivity



(C) Signal Output with No Light showing Very Low Dark Current Feature



(D) Signal Output with Input Light showing No Image Lag Feature



Yoshiaki Hagiwara, Motoaki Abe and Chikara Okada, "A 380H x 488V CCD Imager with Narrow Channel Transfer Gates", Proceeding of 10<sup>th</sup> Conference on Solid State Devices, Tokyo 1978, Japanese Journal of Applied Physics, Volume 18 Sup 18-1, pp. 367-369.