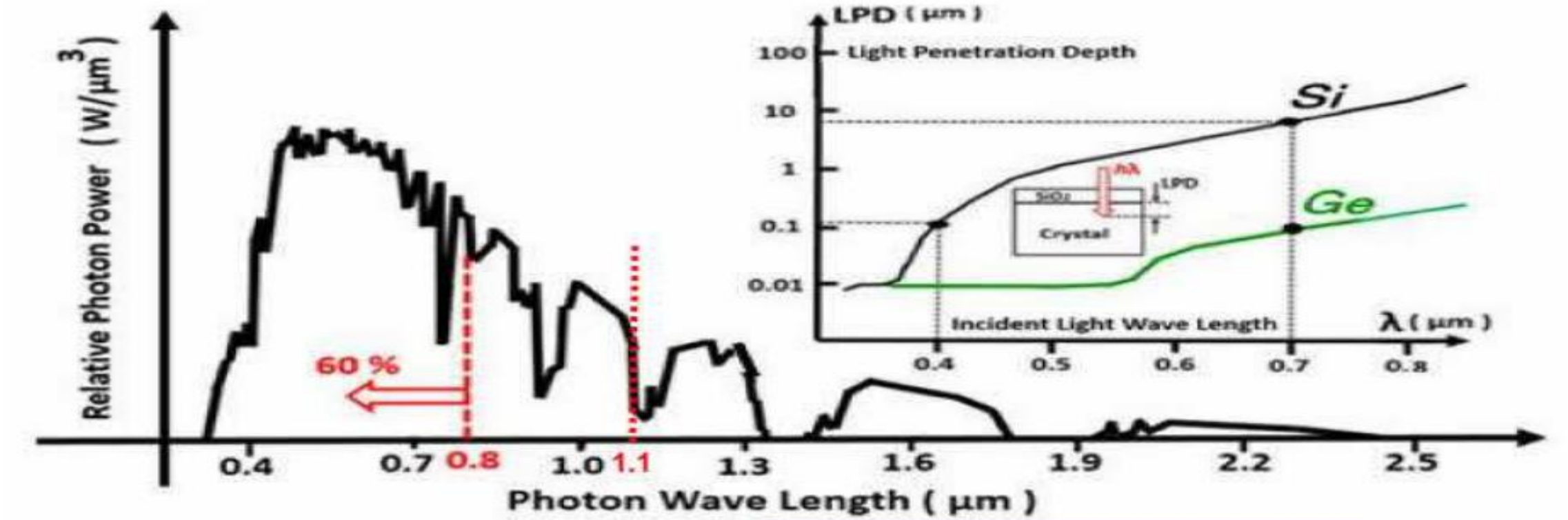
Silicon crystal with the bandgap of 1.1 eV has a very short light penetration depth（LPD), which is about 0.1 μm. Technically, it is impossible to form a shallow PN junction at the silicon surface at that shallow depth. So, the energy component of the short wave blue light is absorbed and wasted as heat. That is why a wide band semiconductor multi-junction type solar cell was desired and developed, such InGaP/GaAs/InGaAs by Sharp and AlGaInP/GaAs/Ge by Spectrum Lab. However they are very costly.



$$E = \hbar\omega = hf = hc/\lambda$$
$$E\,(eV) = 1.24/\lambda\,(\mu m)$$

For Silicon, E_G = 1.10 eV and λ = 1.12 μm

The light energy of the wave length more than λ = 1.12 μm can not be converted to electrical energy in the silicon crystal.

The P+PNPP+_Double_Junction_Solar_Cell_invented_by_Hagiwara_in_2020 may give the right solution.