

InAs and InAsSb single heterostructure photodiodes

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InAs and InAsSb based photodiodes (PDs) operate in the first atmospheric window and promise sufficient advantages over other types of photodetectors in many applications including pyrometry [¹] and gas analysis [²]. In [³, ⁴] an additional broad band gap P-InAs_{1-x-y}Sb_xP_y “window” layer with $y \approx 2.2 \cdot x$ was introduced for performance improvements in InAs PDs operating at temperatures below 300 K. The above improvements were later considered in theoretical and experimental papers on single and double heterostructure (DH) PDs with p-InAsSbP claddings and n-InAs or n-InAsSb active layers operating in a wide temperature range (77-350 K). On the other hand there is limited data on P-InAsSbP/n-InAs heterojunctions as most published devices did not contain the above junction. The latter was thought to be a consequence of an acceptor (Zn) diffusion during the growth process (see, e.g. [⁵]) with the result that a 5-15 μm thick p-InAs(Zn) layer was sandwiched between P-InAsSbP and n-InAs semiconductors.

The report presents data on SH heterostructure PDs for the 3-4 μm spectral range with two epitaxial layers namely P-InAsSbP and n⁰-InAs or n⁰-InAsSb grown onto a n⁺-InAs substrate.

References

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- ¹ G.Yu.Sotnikova, S.E.Aleksandrov and G.A.Gavrilov, “*A³B⁵ photodiode sensors for low-temperature pyrometry*” Proc. of SPIE Vol. 8073, 80731A (2011), doi: 10.1117/12.886309.
 - ² Sotnikova G.Y., Gavrilov G.A., Aleksandrov S.E., Kapralov A.A., Karandashev S.A., Matveev B.A., Remennyi M.A. “*Low Voltage CO₂-Gas Sensor Based on III–V Mid-IR Immersion Lens Diode Optopairs: Where we Are and How Far we Can Go?*” Sensors Journal, IEEE Volume 10, Issue 2, Page(s):225 – 234 (2010), DOI : 10.1109/JSEN.2009.2033259.
 - ³ A.V.Pentsov, S.V.Slobodchikov, N.M.Stus', and G.M.Filaretova, USSR Inventor's Certificate after application №3207490/31-26 from 15.08.1988.
 - ⁴ V.V.Tetyorkin; A.V.Sukach; S.V.Stariy; N.V.Zotova; S.A.Karandashev; B.A.Matveev; N.M.Stus, “*p+-InAsSbP/n-InAs photodiodes for IR optoelectronic sensors*”, Infrared Photoelectronics, Antoni Rogalski; Eustace L. Dereniak; Fiodor F. Sizov, Editors, 5, Proc. of SPIE Vol. 5957, 59570Z, (2005), DOI : 10.1117/12.622181.
 - ⁵ M.Ahmetoglu (Afrailov), “*Photoelectrical characteristics of the InAsSbP based uncooled photodiodes for the spectral range 1.6–3.5 μm* ”, Infrared Physics & Technology, V. 53, Issue 1, Pages 29–32, (2010).