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Heterojunction detectors for multi-band detection with wavelength threshold extension mechanism

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Multi-band photodetectors have received increased attention over the years due to their wide applications in civilian, commercial, medical and military sectors. The photodetectors based on III-V semiconductor heterostructures have been studied extensively for multi-band detection, covering ultra-violet (UV) to far-infrared (FIR) region. Due to material system maturity, GaAs/Al_xGa_{1-x}As heterostructures provide an attractive option demonstrating photodetection covering UV-FIR range. In more recent studies, the conventional spectral threshold limit, that is, $\lambda_t = hc/\Delta$ set by the minimum energy gap Δ , has been overcome owing to a novel detection mechanism arising from the hot-carrier effect in the asymmetrical p-GaAs/Al_xGa_{1-x}As heterostructures. It has been experimentally demonstrated that a detector with a conventional spectral threshold of $\sim 3.1 \mu\text{m}$ shows an extended wavelength threshold of up to $\sim 68 \mu\text{m}$. In addition to the multi-band detection capability, an important advantage of the wavelength extension mechanism is a lower dark current of the detector, which is determined by standard Δ and is evident from close agreement of the experimentally measured dark current data to the theoretical fits based on 3D carrier drift model. Therefore, the wavelength threshold extension mechanism makes it possible to design a detector with its dark current being much lower compared to that of a detector without the extension mechanism. Based on these studies, the III-V semiconductor heterostructures offer potential for multi-band detection from UV to FIR by utilizing appropriate detector architectures.

Biography

A G Unil Perera has received the BS degree in Physics (with first class honors) from the University of Colombo, Colombo, Sri Lanka and an MS and PhD degrees from the University of Pittsburgh. He is currently a Regents' Professor at the Department of Physics and Astronomy, Georgia State University, Atlanta. He is a Fellow of the IEEE, SPIE and APS. He has 8 US patents, 4 edited books, 11 invited book chapters and over 180 publications. He is also a Member of the Editorial Board for the *IEEE Journal of Electron Device Society*.

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