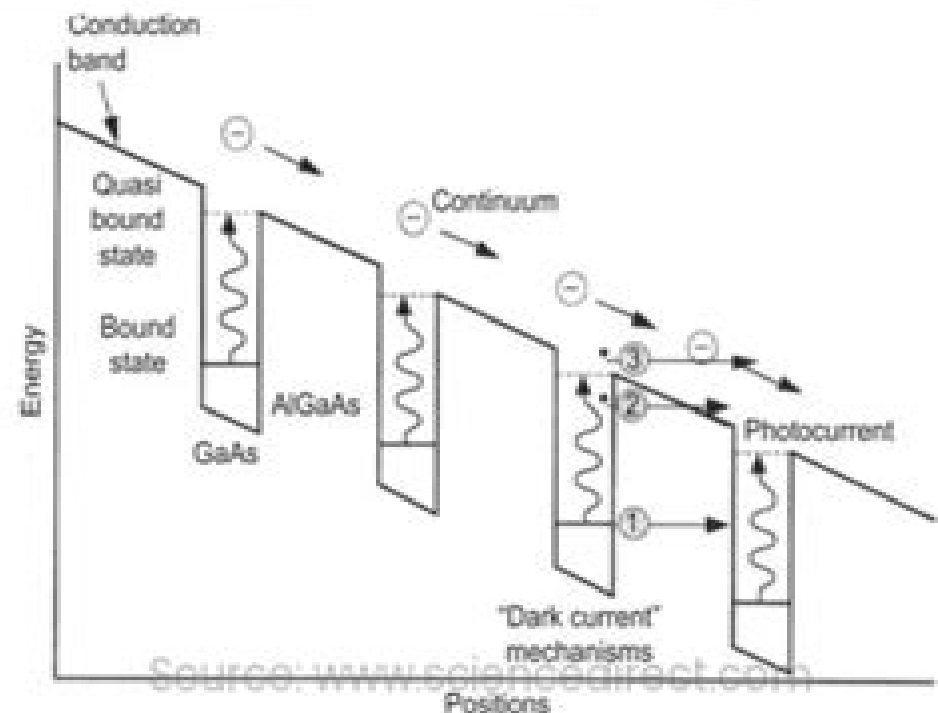
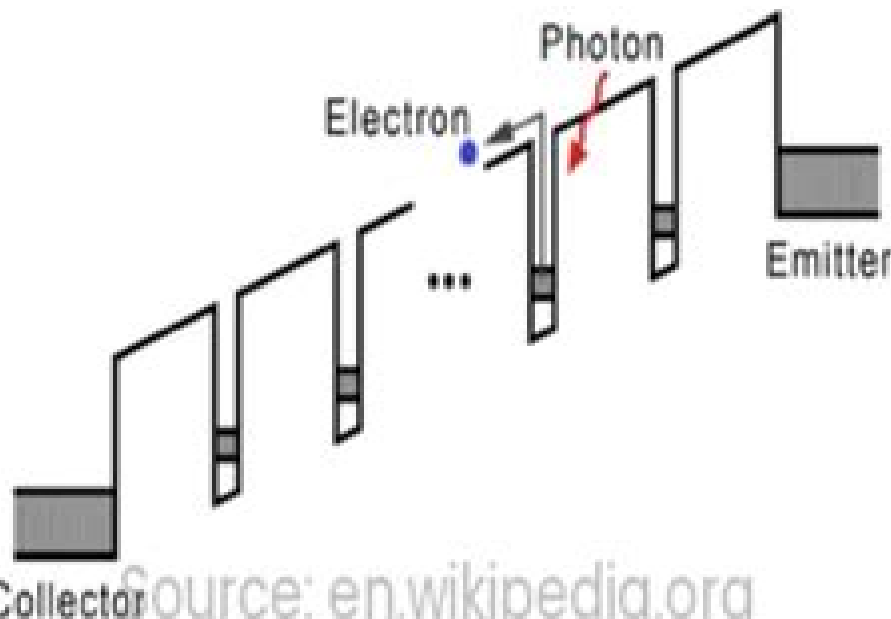


# Quantum Well Infrared Photodetector (Qwip)

- QWIPs, Quantum Well Infrared Photodetectors, are a significant infrared detection technology with advantages like wavelength selectivity and high sensitivity
- Their design allows for the detection of specific wavelengths and weak IR signals
- They have various applications, including thermal imaging, remote sensing, and medical diagnostics
- Future prospects include multi-color detection and integration with other technologies, aiming for more advanced capabilities



# Quantum Well Detectors

**Antoni Rogalski**

A red circular graphic with a gradient, appearing as a stylized arrow or a light effect, positioned to the right of the author's name.

## **Quantum Well Detectors:**

*High Responsivity Tunable Step Quantum Well Infrared Photodetector* Yeo Hwee Tiong, 2004-12-01 In this thesis the performance of a step quantum well infrared photodetector QWIP which was designed to detect a laser spot at 1.05  $\mu\text{m}$  and IR radiation between 9.5  $\mu\text{m}$  to 10.5  $\mu\text{m}$  was evaluated. In the far infrared FIR the maximum responsivity of the test detector at 10 K was measured at 1.02 A/W with a peak wavelength of 10.3  $\mu\text{m}$  under a negative bias of 0.83 V. The D\* at background limited infrared performance BLIP was measured at  $8.0 \times 10^9 \text{ cm}^2 \text{ Hz}^{-1} \text{ W}^{-1}$  with 180 degrees field of view. The BLIP temperature was found to be about 55 K. In addition the FIR detection wavelength found shift with the amount of bias across the device. The amount of shift observed was 0.21 meV/kVcm which is due to linear Stark effect associated with the step quantum well. The quantum well infrared detectors made of square quantum wells found to have an order of magnitude lower Stark shift originated from second order effects. This suggests that the step well infrared detector can have applications in tunable wavelength infrared detectors.

*Quantum Well Infrared Photodetectors* Harald Schneider, Hui C. Liu, 2006-10-18 Addressed to both students as a learning text and scientists/engineers as a reference, this book discusses the physics and applications of quantum well infrared photodetectors QWIPs. It is assumed that the reader has a basic background in quantum mechanics, solid state physics and semiconductor devices. To make this book as widely accessible as possible, the treatment and presentation of the materials is simple and straightforward. The topics for the book were chosen by the following criteria: they must be well established and understood and they should have been or potentially will be used in practical applications. The monograph discusses most aspects relevant for the field but omits at the same time detailed discussions of specialized topics such as the valence band quantum wells.

**Quantum Well Intersubband Transition Physics and Devices** Hui C. Liu, Barry F. Levine, Jan Y. Andersson, 2012-12-06 Intersubband transitions in quantum wells have attracted tremendous attention in recent years mainly due to the promise of applications in the mid and far infrared regions (2–20  $\mu\text{m}$ ). Many of the papers presented in *Quantum Well Intersubband Transition Physics and Devices* are on the basic linear intersubband transition processes, detector physics and detector application reflecting the current state of understanding and detector applications where highly uniform large focal plane arrays have been demonstrated. Other areas are still in their early stages including infrared modulation, harmonic generation and emission.

**The Physics Of Quantum Well Infrared Photodetectors** Kwong-kit Choi, 1997-06-12 In the past infrared imaging has been used exclusively for military applications. In fact it can also be useful in a wide range of scientific and commercial applications. However its wide spread use was impeded by the scarcity of the imaging systems and its high cost. Recently there is an emerging infrared technology based on quantum well intersubband transition in III-V compound semiconductors. With the new technology these impedances can be eliminated and a new era of infrared imaging is in sight. This book is designed to give a systematic description on the underlying physics of the new detectors and other issues related to infrared imaging.

*Infrared*

*Detectors* Antonio Rogalski, 2010-11-15 Completely revised and reorganized while retaining the approachable style of the first edition *Infrared Detectors Second Edition* addresses the latest developments in the science and technology of infrared IR detection Antoni Rogalski an internationally recognized pioneer in the field covers the comprehensive range of subjects necessary to understand the field Characterization and Analysis of a Multicolor Quantum Well Infrared Photodetector, 2006 This thesis presents analysis and characterization of performance of a newly designed multicolor quantum well infrared photodetector QWIP Specifically it focuses on a detector capable of detecting infrared emissions in the near infrared NIR mid wavelength infrared MWIR and long wavelength infrared LWIR Through photocurrent spectroscopy and performance analysis this prototype detector can be classified and prepared for possible future use within the U S Armed Forces Certain military applications require a highly accurate reliable sensitive and multispectral infrared detector to identify targets and ensure mission success By designing and fabricating a multicolor quantum well infrared photodetector simultaneous detection of targets in the near infrared mid wavelength infrared and long wavelength infrared is possible using only one detector In addition power and cooling requirements for quantum well infrared detectors makes them suitable for use in the field

Infrared and Terahertz Detectors, Third Edition Antoni Rogalski, 2019-01-10 This new edition of *Infrared and Terahertz Detectors* provides a comprehensive overview of infrared and terahertz detector technology from fundamental science to materials and fabrication techniques It contains a complete overhaul of the contents including several new chapters and a new section on terahertz detectors and systems It includes a new tutorial introduction to technical aspects that are fundamental for basic understanding The other dedicated sections focus on thermal detectors photon detectors and focal plane arrays **Semiconductor Quantum Wells and Superlattices for Long-wavelength Infrared Detectors**

Mahmoud Omar Manasreh, 1993 Provides a basic understanding of how semiconductor quantum wells and superlattices can be used for long wavelength infrared detectors and related systems It represents a step towards a knowledge of novel structures that could be used for high performance infrared detectors and imaging rays Intersubband Transitions in Quantum Wells

Emmanuel Rosencher, Borge Vinter, Barry F. Levine, 2012-12-06 This book contains the lectures delivered at the NATO Advanced Research Workshop on the Intersubband Transitions in Quantum Wells held in Cargese France between the 9th and the 14th of September 1991 The urge for this Workshop was justified by the impressive growth of work dealing with this subject during the last two or three years Indeed thanks to recent progresses of epitaxial growth techniques such as Molecular Beam Epitaxy it is now possible to realize semiconductor layers e g GaAs with thicknesses controlled within one atomic layer sandwiched between insulating layers e g AlGaAs When the semiconducting layer is very thin i e less than 15 nm the energy of the carriers corresponding to their motion perpendicular to these layers is quantized forming subbands of allowed energies Because of the low effective masses in these semiconducting materials the oscillator strengths corresponding to intersubband transitions are extremely large and quantum optical effects become giant in the 5-20 range

photoionization optical nonlinearities Moreover a great theoretical surprise is that thanks to the robustness of the effective mass theory these quantum wells are a real life materialization of our old text book one dimensional quantum well ideal Complex physical phenomena may then be investigated on a simple model system *New Ternary Alloy Systems for Infrared Detectors* Antoni Rogalski,1994 **Long Wavelength Infrared Detectors** Razeghi,1997-11-21 This work presents a comprehensive overview of the development of new generations of infrared detectors based on artificially synthesized quantum structures Featuring contributions from researchers working at the cutting edge of this field this volume will become an essential reference for advanced graduate students and researchers alike **Advances in Research and Development** ,1995-11-22 Physics of Thin Films is one of the longest running continuing series in thin film science consisting of twenty volumes since 1963 The series contains quality studies of the properties of various thinfilms materials and systems In order to be able to reflect the development of today s science and to cover all modern aspects of thin films the series starting with Volume 20 has moved beyond the basic physics of thin films It now addresses the most important aspects of both inorganic and organic thin films in both their theoretical as well as technological aspects Therefore in order to reflect the modern technology oriented problems the title has been slightly modified from Physics of Thin Films to Thin Films Discusses the latest research about structure physics and infrared photoemissive behavior of heavily doped silicon homojunctions and Ge and GaAs based alloy junctions Reviews the current status of SiGe Si quantum wells for infrared detection Discusses key developments in the growing research on quantum well infrared photodetectors QWIPs Reviews Cho's development of a family of novel three terminal multi quantum well devices designed to improve high temperature IR detectivity at long wavelengths Describes recent studies aimed at using multi quantum well structures to achieve higher performance in solar cell devices based on materials systems Handbook of Infrared Detection Technologies M. Henini,M Razeghi,2002-12-11 Introduction Comparison of Photon and Thermal Detectors Performance GaAs AlGaAs Based Quantum Well Intra red Photodetector Focal Plane Arrays GaInAs P Based Qwips on GaAs InP and Si Substrates for Focal Plane Arrays InAs Galn Sb Superlattices A Promising Material System for Infra red Detection GaSb InAs Superlattices for Infra red FPAs MCT Properties Growth Methods and Characterization HgCdTe 2D Arrays Technology and Performance Limits Status of HgCdTe MBE Technology Silicon Infra red Focal Plane Arrays PolySiGe Uncooled Microbolometers for Thermal Infra red Detection Infra red Silicon Germanium Detectors Fundamentals of Spin Filtering in Ferromagnetic Metals with Application to Spin Sensors **Proceedings of the First International Symposium on Long Wavelength Infrared Detectors and Arrays: Physics and Applications** Farhad Radpour,Victor R. McCrary,1995 **Confined Electrons and Photons** Elias Burstein,Claude Weisbuch,2012-12-06 The optical properties of semiconductors have played an important role since the identification of semiconductors as small bandgap materials in the thinies due both to their fundamental interest as a class of solids having specific optical propenies and to their many important applications On the former aspect we can cite the

fundamental edge absorption and its assignment to direct or indirect transitions many body effects as revealed by exciton formation and photoconductivity On the latter aspect large scale applications such as LEDs and lasers photovoltaic converters photodetectors electro optics and non linear optic devices come to mind The eighties saw a revitalization of the whole field due to the advent of heterostructures of lower dimensionality mainly two dimensional quantum wells which through their enhanced photon matter interaction yielded new devices with unsurpassed performance Although many of the basic phenomena were evidenced through the seventies it was this impact on applications which in turn led to such a massive investment in fabrication tools thanks to which many new structures and materials were studied yielding further advances in fundamental physics

Resonant Infrared Detectors And Emitters Kwong-kit Choi, 2024-05-24 This book is a sequel of *The Physics of Quantum Well Infrared Photodetectors* 1997 which covered the basic physics of QWIPs In the intervening 27 years QWIP properties pertinent to infrared detection are much better understood and QWIP technology has become a mainstream widely deployed infrared technology The main progress is the ability to know the QWIP absorption quantum efficiency quantitatively through rigorous electromagnetic modeling The lack of theoretical prediction has impeded QWIP development for a long time Generally an arbitrary choice of detector structures yields substantial variations of absorption properties and QWIP was regarded as a low quantum efficiency detector With the advent of electromagnetic modeling quantum efficiency of any detector geometry can be known exactly and be optimized to attain a large satisfactory value Consequently all properties of QWIPs are predictable not unlike prevailing silicon devices This unique characteristic enables QWIP to be the most manufacturable long wavelength infrared technology in mass production This book by K K Choi a co inventor of QWIPs will capture this exciting development Based on the materials expounded in the book the reader will know key performance metrics in infrared detection in depth knowledge of QWIP material and structural designs array production its application and practical knowledge of electromagnetic modeling In addition the book will describe using micro and nano structures to enhance the emission properties of active and passive optical emitters similar to detectors The application of rigorous electromagnetic modeling to optical emitters is new to the optoelectronic community The resonator pixel emitter structure with its modeling method will no doubt be able to attract substantial academic and industrial attention in years to come

Detection of Light George H. Rieke, 2021-05-13 Comprehensive accessible and physically based description of the approaches currently used to detect light from X ray to mm wave

**Long Wavelength Infrared Detectors** Manijeh Razeghi, 2020-03-09 This timely work presents a comprehensive overview of the development of new generations of infrared detectors based on artificially synthesized quantum structures The growth of quantum wells and superlattices is well documents in this volume as are the principal new superlattice technologies for long wavelength infrared detection Featuring insightful contributions from researchers working at the cutting edge of this exciting field this volume is sure to become an essential reference for advanced graduate students and researchers alike

*Technology 2001* , 1991 Infrared Detectors

and Emitters: Materials and Devices Peter Capper, C.T. Elliott, 2013-11-27 Infrared IR detectors fall into two main categories thermal and photon The earliest detectors of IR were thermal in nature e g thermometers The subsequent developments of these detectors such as thermopiles resistance bolometers Golay cells and pyroelectric detectors can operate at ambient temperature but have disadvantages of insensitivity and slowness A wide variety of semiconductor photon detectors have been developed and these possess very high sensitivity high frequency response but have the disadvantage of needing cryogenic cooling particularly at longer wavelengths In the main the applications have been in the military sphere but widespread industrial and scientific applications also exist The majority of development funding for these semiconducting IR detectors has however come from military sources This book is an attempt to provide an up to date view of the various IR detector emitter materials systems currently in use or being actively researched The book is aimed at newcomers to the field and at those already working in the IR industry It is hoped that the former will find the book readable both as an introductory text and as a useful guide to the literature Workers in one of the various IR areas will hopefully find the book useful in bringing them up to date with other sometimes competing technologies To both groups of readers we trust that the book will prove interesting thought provoking and a spur to further progress in this fascinating and challenging field of endeavour

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