Hybrid AlGaN-SiC Avalanche Photodiode for Deep-UV Photon Detection

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The proposed device is capable of counting ultraviolet (UV) photons, is compatible for inclusion into space instruments, and has applications as deep-UV detectors for calibration systems, curing systems, and crack detection. The device is based on a Separate Absorption and Charge Multiplication (SACM) structure. It is based on aluminum gallium nitride (AlGaN) absorber on a silicon carbide APD (avalanche photodiode). The AlGaN layer absorbs incident UV photons and injects photogenerated carriers into an underlying SiC APD that is operated in Geiger mode and provides current multiplication via avalanche breakdown.

The solid-state detector is capable of sensing 1000 to 365-nanometer wavelength radiation at a flux level as low as 6 photons/pixel/s. Advantages include, high gain, and Geiger mode operation at low voltage. Furthermore, the device can also be designed in array formats, e.g., linear arrays or 2D arrays (micropixels inside a superpixel).

This work was done by Shahid Aslam, Federico A. Herrero, and John Sigwarth of Goddard Space Flight Center and Neil Goldsman and Akin Akturk of The University of Maryland. Further information is contained in a TSP (see page 1), GSC-15604-1.

High-Speed Operation of Interband Cascade Lasers

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Optical sources operating in the atmospheric window of 3–5 µm are of particular interest for the development of free-space optical communication link. It is more advantageous to operate the free-space optical communication link in 3–5-µm atmospheric transmission window than at the telecom wavelength of 1.5 µm due to lower optical scattering, scintillation, and background radiation. However, the realization of optical communications at the longer wavelength has encountered significant difficulties due to lack of adequate optical sources and detectors operating in the desirable wavelength regions.

Interband Cascade (IC) lasers are novel semiconductor lasers that have a great potential for the realization of high-power, room-temperature optical sources in the 3–5-µm wavelength region, yet no experimental work, until this one, was done on high-speed direct modulation of IC lasers. Here, high-speed interband cascade laser, operating at wavelength 3.0 µm, has been developed and the first direct measurement of the laser modulation bandwidth has been performed using a unique, high-speed quantum well infrared photodetector (QWIP). The developed laser has modulation bandwidth exceeding 3 GHz. This constitutes a significant increase of the IC laser modulation bandwidth over currently existing devices. This result has demonstrated suitability of IC lasers as a mid-IR light source for multi-GHz free-space optical communications links.

This work was done by Alexander Soibel, Cory J. Hill, Sam A. K ao, Malcolm W. Wright, and William H. Farr of Caltech; Rui Q. Yang of the University of Oklahoma; and H.C. Liu of the Institute for Microstructural Science for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1), NPO-46738.