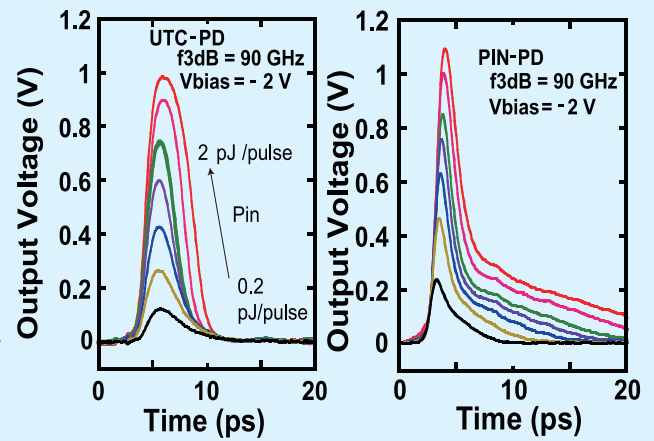




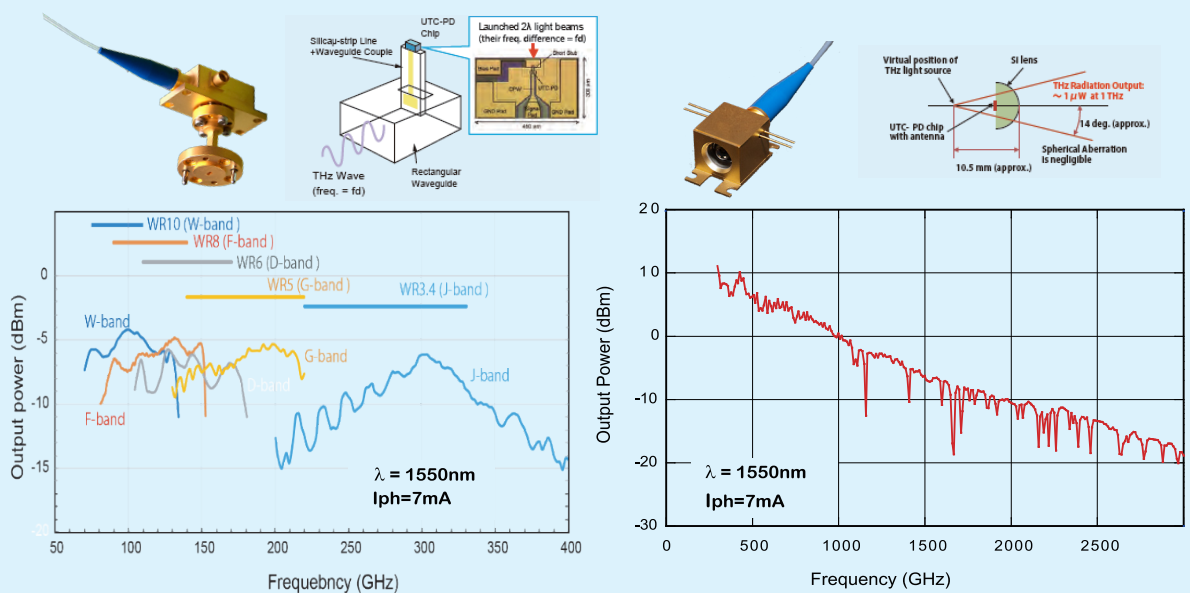
## KEY CONCEPTS OF UTC

UTC-PD was developed by NTT in Japan. A UTC diode features a moderately p-doped InGaAs absorption layer and a depleted, undoped or lightly n-doped InP carrier collection layer. Photocarriers are generated in the absorption layer. The electrons diffuse/drift into the collection layer, due to an additional diffusion block, not to the p-contact layer. The holes, by contrast, travel to the p-contact but do not enter the collection layer. Thus, only the electrons cross the collection layer. This type of carrier transport is substantially different from conventional p-i-n diodes, where both electrons and holes contribute to the high-frequency photocurrent.



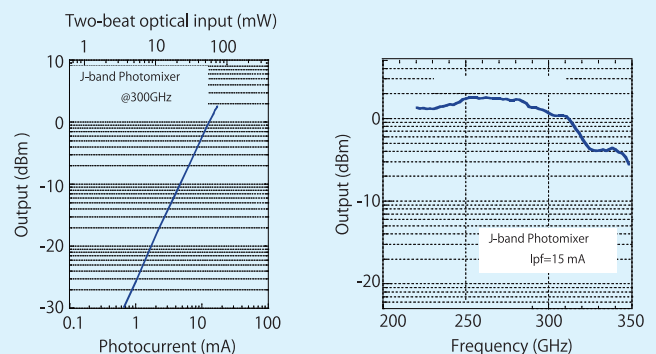
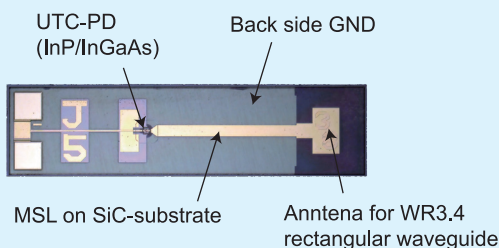
## UTC-Photomixer (InP Chip Type)

In the waveguide-output photomixer, the output from the InP UTC-PD chip is connected to a microstrip RF board incorporating a waveguide antenna. By integrating a resonant circuit on the chip that matches the waveguide's frequency band, the photomixer achieves flat response and high output power. In quasi-optical photomixers, a self-compensating bowtie antenna is integrated within the InP UTC-PD to achieve a wide-band output spectrum.



## UTC-Photomixer (InP\_on\_SiC Chip Type)

The introduction of heterogeneous material bonding technology onto SiC substrate has demonstrated an increase in the output of InP/InGaAs UTC-PDs through a collaborative research project<sup>\*1)</sup> between NTT Innovative Devices Corp. and a Japanese university team. We are moving forward with commercialization of this product as our top candidate for a J-band photomixer. At NTT Devices, we are developing InP-on-SiC technology with the aim of adapting it to all frequency bands.



\*1) This result was based in part on research conducted by The University of Osaka, Kyushu University, and The University of Tokyo under commission from the National Institute of Information and Communications Technology (NICT), Japan; Beyond 5G R&D Promotion Program (JPJ012368C-00901)