Technology Opportunity

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Technology Transfer & Partnership Office

TOP3–00182

Photonic Receiver for High Data Rate Applications

Technology

The National Aeronautics and Space Administration (NASA) seeks to transfer technology for a development and production of a photonic receiver based on microphotonic resonator technology.

Benefits

- Ten times smaller volume, weight, and power consumption
- Ten times greater sensitivity
- Scalable to higher nm-wave frequencies without loss of efficiency
- Lower power consumption
- High response sensitivity
- Packaging integration compatible with silicon material
- Optical isolation of antenna

Commercial Applications

- Wireless microcell cellular systems
- ATM/Sonet, Ethernet, and fiber-optic-distributed data interface
- High-speed, long-haul fiber-optic links for voice, data, and digital video
- Metropolitan and wide area networks
- CATV networks
- Wavelength division multiplexing systems

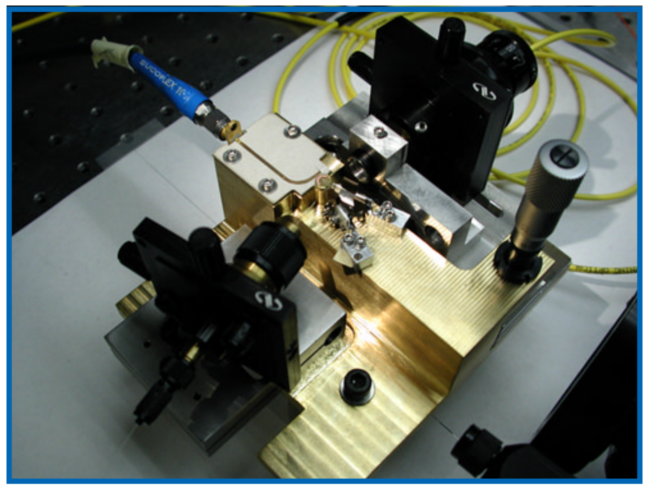

Figure 1.—Photograph of the side-coupled resonant traveling-wave $LiNbO_3$ microdisk used to modulate an optical carrier with a radio frequency (RF) signal.

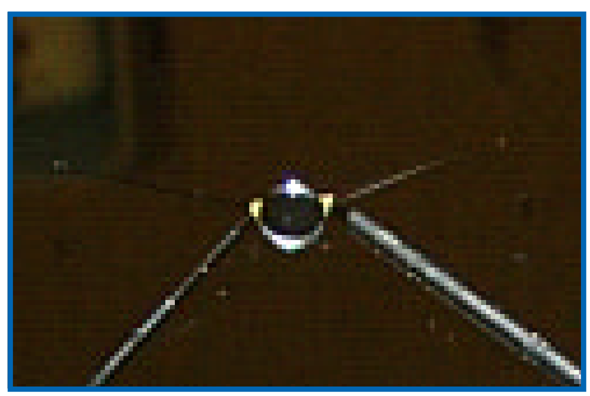

Figure 2.—Photograph of microdisk-based photonic receiver integrated on-chip silicon wafer to validate packaging concept. The on-chip integration shows input fiber/output collimating fiber, two microprism, microdisk, and two prism tuning rods.

Technology Description

A key innovation in this optical receiver design is the use of an electro-optic disk to modulate an optical carrier with the received RF signals, in which both optical and RF signals are simultaneously in resonance, resulting in power-efficient RF-to-optical conversion in a small volume, and lower power consumption. Compared with current receiver design, this microdisk approach can perform efficient optical modulation without relying on a reference arm typical of Mach-Zender modulators to convert phase to amplitude modulation.

A microphotonic optical resonator is fabricated from an electro-optical material. The optical quality factor (Q) of the resonator is high thereby increasing the effective interaction length of photons with an applied RF electric field. When combined with a simultaneously resonant RF electrical feed for voltage gain and patterned electrodes structure, high-sensitivity at millimeter-wave frequencies can be achieved.

Shown in figures 1 and 2 are the photographs of the optical receiver on a testbed platform and integrated receiver assembly on silicon carrier, respectively. It has been demonstrated that the minimal detectable microwave power is less than 2.5 nW with about 14 dB signal-to-noise ratio, corresponding to the noise floor of 0.1 nW. This device has operational capabilities in the frequency range from 1 to 100 GHz at 1330 nm and 1550 nm wavelengths.

Options for Commercialization

NASA has filed a patent application for this technology and is seeking partners in industry and academia to continue developing this packaging concept and pursuing a commercialization plan. If you are interested in learning more about this technology, please contact us.

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Reference

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Key Words

Microphotonic
Electro-optic microdisk
Optical receiver
Resonator