

On-Chip Interferometer

by
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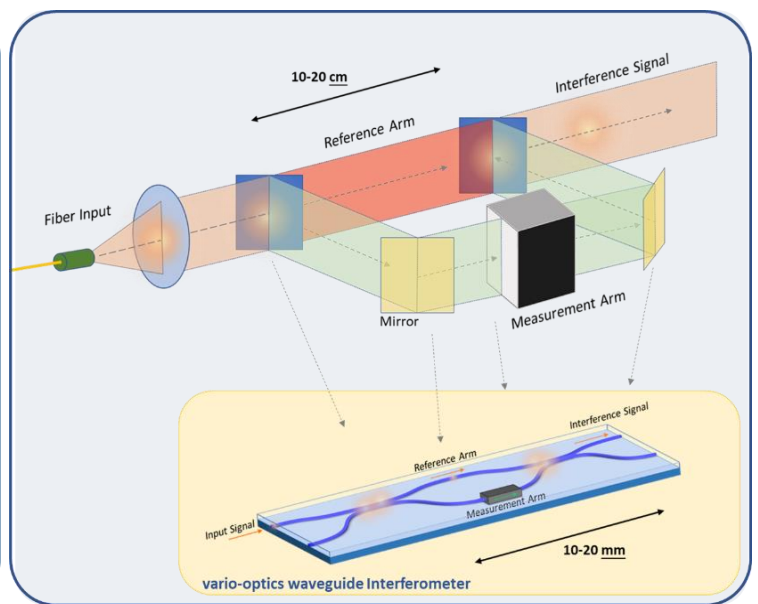
Planar Waveguide Mach-Zehnder-Interferometers

Interferometry is a widely used measurement technique in industry and science, employed in a multitude of applications including spectroscopy, distributed fiber sensing and telecommunications.

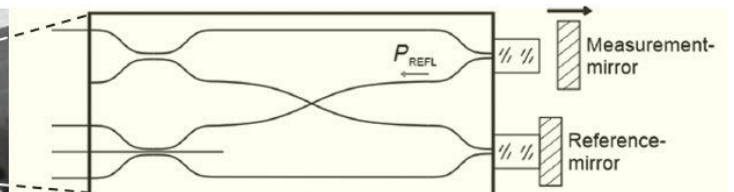
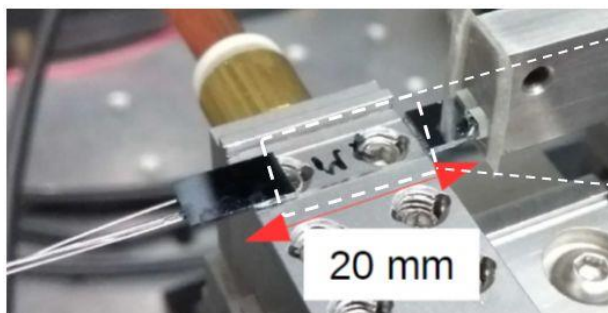
vario-optics planar singlemode waveguide technology allows the fabrication of on-chip directional couplers, which can be used as Mach-Zehnder-interferometers (MZI). Directional Couplers allow both the splitting of the input signal into a reference & measurement beam, and vice versa to interfere two beams in the evanescent coupling region, thereby creating a highly sensitive output signal.

Advantages of on-chip integration:

- **reduced complexity & low cost**
as a result of the high integration density & small footprint
- **increased stability**
the compact design and on-board integration reduces thermal drifts and mechanical vibrations compared to free-space/fiber optics systems
- **versatile design**
dimensions /wavelength /splitting ratio can easily be adjusted to customer requirements



Examples of MZIs realized by **vario-optics** include displacement sensors [1], gas sensors, temperature sensors [2] and thermo-electric switches [3].



Example of an integrated displacement sensor based on a MZI with a measurement range of 200 μm and few nm resolution.

References

- [1] J. Kremmel, N. Cramer, T. Lamprecht & M. Michler, "Passive aligned assembly of an integrated optical displacement sensor based on a reflective Mach-Zehnder interferometer with a 3x3 directional coupler," *Opt. Eng.* 57(8), 2018
- [2] J. Kremmel, T. Lamprecht, and M. Michler, "Measurement of the thermo-optical effect of integrated waveguides," *Proc.SPIE*, vol. 9891, pp. 9891 – 9891 – 8, 2016
- [3] J. Kremmel, M. Michler, T. Lamprecht, and N. Cramer, "Polymer optical waveguide based thermo-optical switch on a metal-core pcb-substrate," in *Advanced Photonics 2017 (IPR, NOMA)*, p. PTh1D.1, OSA, 2017