

Optical sensing using InP integrated photonics

Citation for published version (APA):

Williams, K. A., Latkowski, S., Moskalenko, V., Llorens Revull, M., & Bente, E. A. J. M. (2016). Optical sensing using InP integrated photonics. In *Progress in Electromagnetic Research Symposium (PIERS), 8-11 August 2016, Shanghai, China* (pp. 2681-2681). Institute of Electrical and Electronics Engineers.
<https://doi.org/10.1109/PIERS.2016.7735095>

DOI:

[10.1109/PIERS.2016.7735095](https://doi.org/10.1109/PIERS.2016.7735095)

Document status and date:

Published: 10/11/2016

Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
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Optical Sensing Using InP Integrated Photonics

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Abstract— Optical sensing offers unrivalled precision with real-time monitoring, but the complexity in implementing the optical sources has so far limited deployments to high value measurement systems. Innovations in photonic integration are beginning to enable breakthroughs in terms of cost, size and performance. Integrated sources and readouts can be created with large-scale semiconductor wafer production techniques. InP integrated photonics is able to combine best-in-class components including the lasers and amplifiers within one photonic chip. The chip-scale integration of complete circuits enables on-chip stabilisation and environmental corrections for further advances in measurement precision and at lower power consumption.

PIC-enabled photonic sources and readouts may be expected to enhance performance in fiber optical sensors for distributed strain and temperature sensing in structural health-monitoring. PICs can also be used directly for advanced imaging in sub-surface optical coherence tomography. Low line-width tunable laser sources may be used for spectral signature recognition in gas sensing. As the systems are miniaturised, future applicability is foreseen in safety systems and health diagnostics through to environmental monitoring and metrology.

In this paper we review the key components required to reach enable high photonic precision. We cover monolithic high-precision tunable laser systems which are now feasible with sub-MHz linewidths and single mode tuning over tens of nanometers. We also review more recent work in comb laser sources which may enable massive parallelism for order of magnitude increases in sampling rates. Performance attributes may now be tailored for specific sensing functions on the same generic integration platforms. The careful configuration of active, passive and coupling building blocks is now feasible on stable industry processes using generic integration methodologies. This paper gives an overview of the opportunities and challenges.

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