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Citation for published version (APA):

Dolores Calzadilla, V. M., Heiss, D., & Smit, M. K. (2013). Nanometallic lasers for optical interconnects. In *Proceedings of the 18th OptoElectronics and Communications Conference / Photonics in Switching (OECC/PS 2013)*, 30 June - 4 July 2013, Kyoto, Japan

Document status and date:

Published: 01/01/2013

Document Version:

Accepted manuscript including changes made at the peer-review stage

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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- The final published version features the final layout of the paper including the volume, issue and page numbers.

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Nanometallic lasers for optical interconnects

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Abstract

Semiconductor nanolasers with metallo-dielectric cavities are considered as promising light sources for optical interconnects. We review the first demonstrated devices of this type and outline our current research efforts on a waveguide-coupled nanolaser.

I. INTRODUCTION

Semiconductor nanolasers provide an attractive route towards high density photonic integrated circuits in low power applications such as optical interconnects. Such lasers exploit metallic and dielectric confinement to provide high quality factors in wavelength-scale cavities, that provide efficient cooling and cross-talk immunity due to the metal coverage. We demonstrated first devices operational at cryogenic temperatures in 2007 [1], and recently reported devices operating at room-temperature [2]. In a next step we are developing a waveguide-coupled nanolaser compatible with the integration in an InP-membrane photonic platform allowing more complex applications. The design is based on a pillar with rectangular cross section ($300 \times 400 \text{ nm}^2$) encapsulated with SiO_2 and a silver cladding. Initial simulations show promising characteristics with an expected operating wavelength near $1.55 \mu\text{m}$, a high quality factor exceeding 500 and waveguide coupling efficiency better than 0.45. The nanoscale design results in a low threshold current below $100 \mu\text{A}$, while output powers up to $100 \mu\text{W}$ seem feasible. We will present optical and electrical simulations and discuss the challenges of fabricating such nanoscale optical devices.

ACKNOWLEDGMENTS

This work was supported by the EU FP7 project NAVOLCHI and ERC project NOLIMITS.

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