75th ECTC 2025

Students‘ Competition

# Exploration of Thermal-Mechanical Challenges for Heterogeneously Integrated Opto-Electronic Packages

Students‘ Competition Team

# Exploration of Thermal-Mechanical Challenges for Heterogeneously Integrated Opto-Electronic Packages

IEEE ELECTRONICS PACKAGING SOCIETY

ECTC The 2025 IEEE 75th Electronic Components and Technology Conference

## Context:

Photonic devices co-packaged with processors for compute in data centers have the potential to significantly increase communication bandwidth while reducing power consumption. Likewise, heterogeneous integration of opto-electronics is poised to make impacts in compact solid-state sensing for a range of mobility and bio-sensing applications.

## Challenge:

- Select an application of interest related to either heterogeneous co-packaged optics for compute or opto-electronic packaging for sensing
- Define, based on the selected application, a relevant package structure (incl. geometry, materials) along with appropriate thermal loads and boundary conditions. Provide clear justification for the selected problem setup.
- Construct a thermal and/or thermal-mechanical (e.g., computational or analytical) model of the package to understand heat transfer and/or mechanical reliability performance bottlenecks
- Propose innovative technical (e.g., package cooling or stress mitigation) solutions based on a survey of state-of-the-art literature
- Investigate proposed solutions (again either numerically or analytically) to quantify thermal-mechanical performance improvements

If you select this challenge, use in the emails title code: **Ch4**

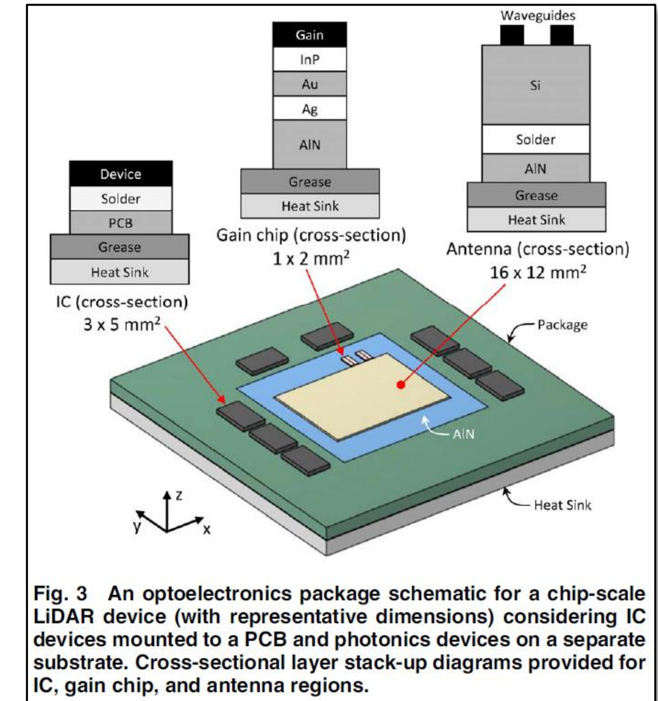


**Fig. 3** An optoelectronics package schematic for a chip-scale LiDAR device (with representative dimensions) considering IC devices mounted to a PCB and photonics devices on a separate substrate. Cross-sectional layer stack-up diagrams provided for IC, gain chip, and antenna regions.

**Suggested References:**


1. Lohan, D. J., Dede, E. M., and Schmalenberg, P. Solid-State LiDAR With Optimized Dynamic Beam Power Intensity for Reduced Thermal Load *ASME Open J. Engineering* ASME. January 2024 3 031021 doi: https://doi.org/10.1115/1.4065898
2. R. Mahajan *et al*., "Co-Packaged Photonics For High Performance Computing: Status, Challenges And Opportunities," in *Journal of Lightwave Technology*, vol. 40, no. 2, pp. 379-392, 15 Jan.15, 2022, doi: 10.1109/JLT.2021.3104725.
3. R. Enright et al., "A Vision for Thermally Integrated Photonics Systems," in Bell Labs Technical Journal, vol. 19, pp. 31-45, 2014, doi: 10.15325/BLTJ.2014.2364431.