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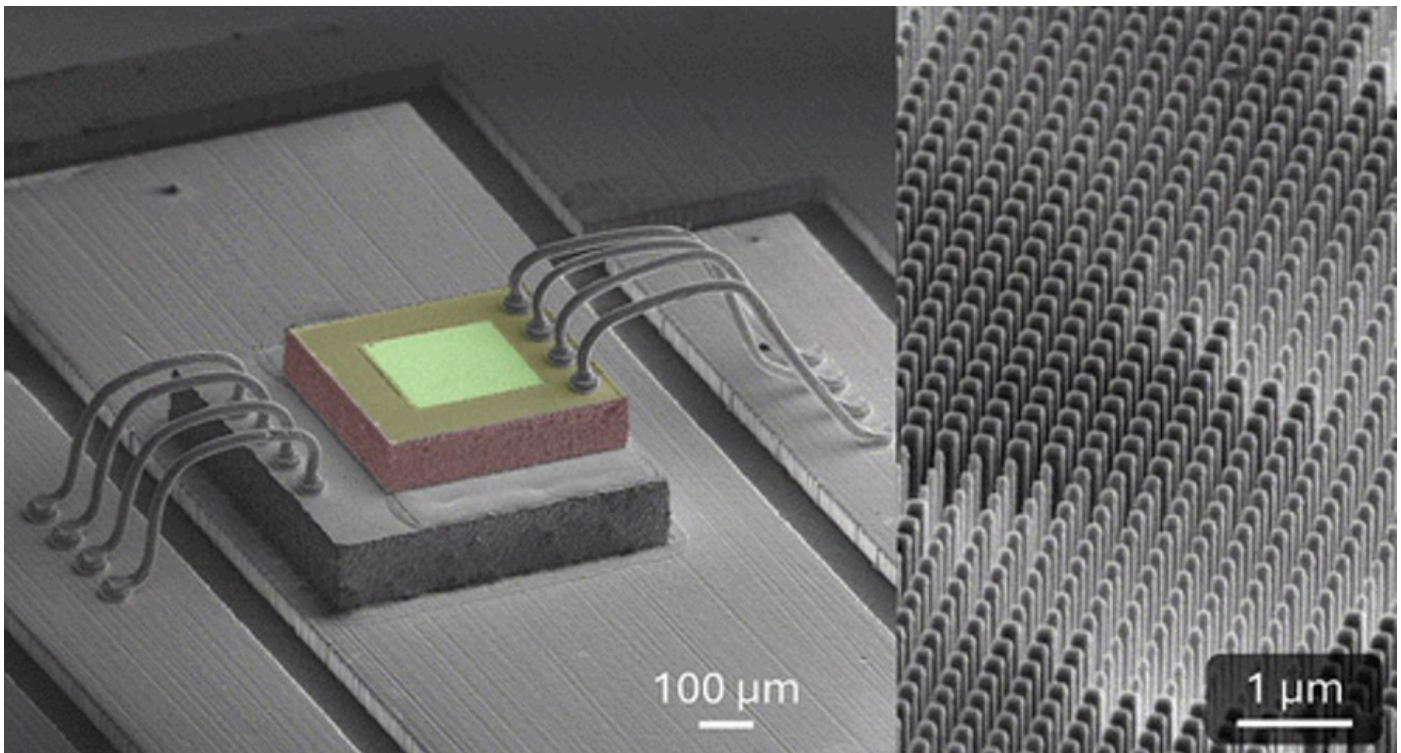
## NEWS

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Research Highlights Publish Date : 2025-08-11

# NYCU and HHRI Develop World's Smallest Chip-Scale Projector, Spotlighted on Nano Letters Cover



Edited by Chance Lai

In a significant leap forward for spatial computing, researchers from National Yang Ming Chiao Tung University (NYCU) and the Semiconductor Division of Hon Hai Research Institute (HHRI) have

This innovation showcases Taiwan's leadership in nanoscale optics and semiconductor integration. It sets a solid technological foundation for the future of spatial computing, from AR glasses to next-generation

jointly developed the world's first monolithically integrated metasurface–photonic crystal surface-emitting laser (meta-PCSEL). This breakthrough enables chip-scale depth projection systems, opening new possibilities for ultra-compact, energy-efficient AR, VR, and wearable devices.

The collaborative team was led by Dr. Hao-Chung Kuo, Chair Professor at NYCU and Director of HHRI's Semiconductor Division, working alongside Division Manager Yu-Heng Hong, researchers Wen-Cheng Hsu and Wen-Chien Miao, and NYCU Assistant Professor Yao-Wei Huang from the Department of Photonics.

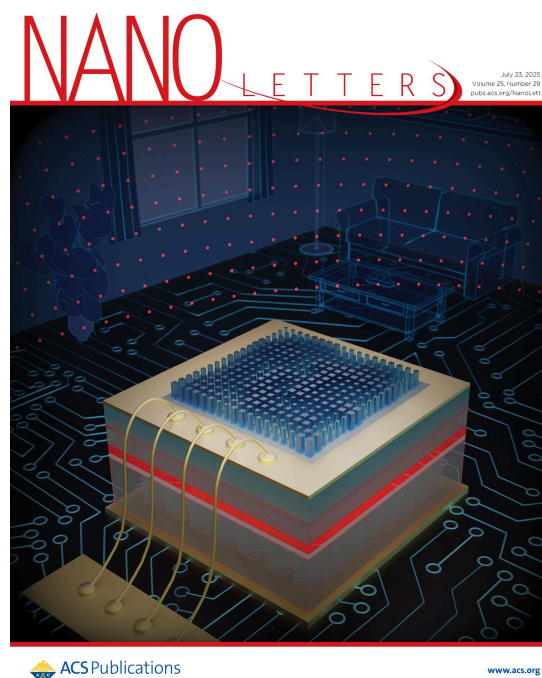
Their study, [Monolithically Integrated Metasurface on a PCSEL for Depth Perception](#), has been published in Nano Letters and selected as the cover story for the July 2025 issue.

### World's Smallest Projector: 0.025 mm<sup>3</sup> Chip-Scale Technology

This milestone builds on the team's 2024 achievement, [Metasurface- and PCSEL-Based Structured Light for Monocular Depth Perception and Facial Recognition](#), pushing the limits of integrated photonics to achieve a chip-scale dot projection

mobile and wearable devices.

The team envisions the technology accelerating the miniaturization and mass adoption of AR, VR, and spatial computing platforms, expanding possibilities for immersive digital experiences across industries.

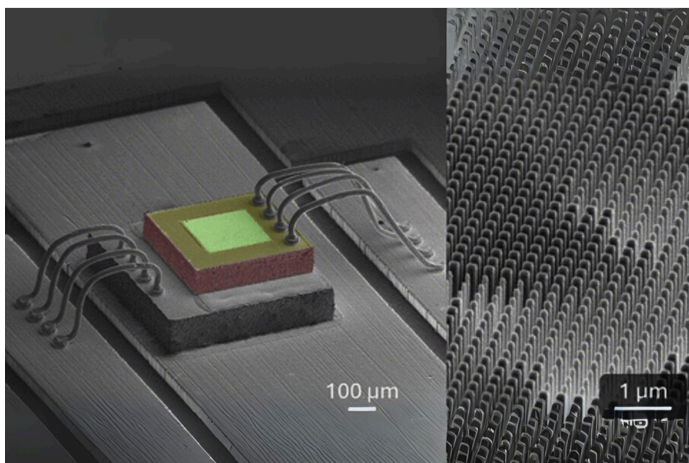


*Nano Letters is one of the world's leading nanoscience and technology journals, with an impact factor consistently above 10. The study was selected as the cover story for its July 2025 issue.*

system for the first time.

The new meta-PCSEL technology reduces the projector's volume to  $0.025 \text{ mm}^3$ —making it the smallest in the world. Compared to dot projectors in commercial smartphones, the device is 2,450 times smaller and consumes 28.7% less power. Single-chip integration significantly lowers system complexity and power requirements, offering a highly competitive solution for industrial adoption.

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