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Hardware Innovations for Cybersecurity

Photonic encryption enhances cybersecurity

Research Project VE-SILHOUETTE

Cavity in PIC with silicon stops and Flip chip bumps

One of the most important security concerns affecting the Internet of Things (IoT) is attacks on hardware IoT devices. Past attacks have targeted not just industry or business, but many end users, such as users of online services.

As the number of connected devices increases, so the cyber risks intensify. Forecasts predict an increase in the number of IoT devices from 30 billion to 75 billion by 2025. Photonic data transmission and computation technology can help make these systems more secure.

Photonic-electronics platform

The joint European project VE-Silhouette »Silicon Photonics for Trusted Electronic Systems« is developing wiretapping-proof communication technology with a standardized and modular photonics-electronics platform designed to protect sensitive data from misuse by third parties.

The proposed electro-optical platform solution will allow photonic components to connect flexibly to open processor systems via optical and electrical interfaces. A prerequisite for this is an electro-optical interposer and the assembly of photonic components, the design and processing technology for which are being developed with input from Fraunhofer IZM researchers.

Contributions of Fraunhofer IZM:

- Developing and integrating the micro- and optoelectronic components for the interposer
- Developing solder-assisted self-alignment with mechanical stops for a cost-effective setup of electro-optical interfaces for data security

Project partners

- Fraunhofer IPMS
- Fraunhofer IZM
- Fraunhofer HHI
- TU Dresden, IAVT
- TU Dresden, Institute of Communication Technology
- OSRAM Opto Semiconductors GmbH
- qutools GmbH

Project volume

- € 15 million
- 80 % Funding share

Duration & Funding code

- 05/2021 - 04/2024
- 16ME0314

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Velektronik

With a diameter of less than one micrometer, the waveguides on optical integrated circuits are extremely small, making the active alignment of such components very complex and cost-intensive.

Fraunhofer IZM is developing a passive alternative, based on solder-assisted self-alignment with integrated mechanical stops. The approach can help produce photonic circuits more economically and in large enough quantities to be a feasible choice for SMEs.

Photonic signals are ideal for transmitting safety-critical information. They are more difficult to manipulate and therefore much more secure against eavesdropping.

Security functions can be implemented photonically for added trustworthiness of electronic systems.

Advantages of silicon photonics:

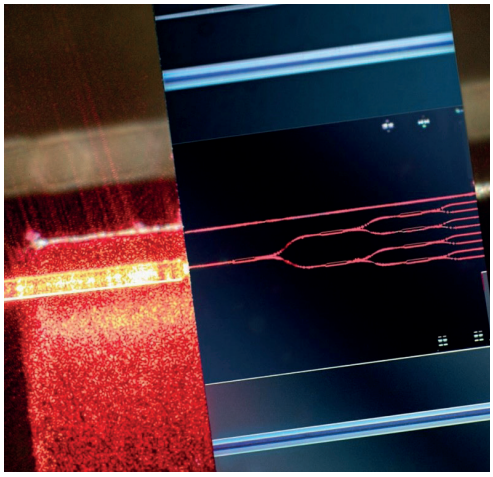
- Better protection against eavesdropping
- Faster calculations
- Lower energy consumption

Silicon photonics application areas:

- Data communication

Other areas of application:

- Data processing with photonic neural networks
- AI applications
- Simulations
- Complex mathematical optimization problems
- High-performance computing
- Photonic sensor technology
- Telecommunications



Solder-assisted self-alignment enables the cost-effective construction of electro-optical interfaces for data security.

Red light: flooded photonic integrated circuit as test vehicle. The photonic integrated circuit shown here represents the design and fabrication in SiN technology.

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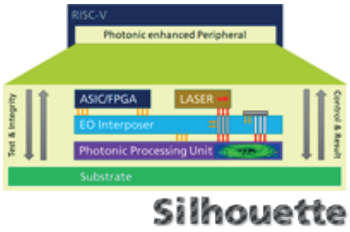
Project Status (10/2023):

Initial tests of the method have shown that several hundred diodes can be integrated simultaneously using self-alignment in the soldering process. Scaled up for industrial production, this parallel mass reflow of laser diodes can reduce the production costs of interposers by up to 95 percent.

The integrity of the safety-relevant functions is ensured by built-in self-testing procedures. In addition to the fundamental electronic and photonic components, the project is also working on the assembly and interconnection technologies as well as the manufacturing processes for electro-optical integration on actual production lines.

The »Silhouette« project will produce two technology demonstrators with different approaches for trustworthy electronics.

- To reliably realize encrypted communication, the first demonstrator includes a random number generator in one of the two E/O platforms to provide random numbers for generating digital keys.
- The second demonstrator includes direct key generation in the photonic domain for subsequent electro-optical conversion.



More information

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