Coordinated by

Fraunhofer

Implemented by

Forschungsfabrik Mikroelektronik Deutschland

Joint Technology development by IMB-CNM (CSIC) and Fraunhofer IZM

Fernández-Tejero, Javier[1]; Fonseca, Luis[1]; Fritzsch, Thomas[2]; Martínez-Domingo, Carme [1]; Pérez, Sandra[1]; Tschoban, Christian[2]; Ullán, Miguel[1]

[1]Institute of Microelectronics of Barcelona (IMB-CNM, CSIC)
[2]Fraunhofer IZM

APECS is the novel pan-European pilot line to establish a groundbreaking infrastructure for 3D heterogeneous integration: By combining the know-how of our partners we will offer services, capabilities and training for European companies and research organizations to integrate and package chiplets and further advanced electronic components into novel electronic systems. By joining forces of Europes´ leading RTOs, the platform of capabilities to be developed will include novel characterization, quality assurance, testing & reliability methodologies and a System-Technology Co-Optimization (STCO) design framework to ensure quality, reliability, security, green manufacturing and fast production ramp-up in collaboration with manufacturing organizations. IMB-CNM (CSIC) and Fraunhofer IZM have complementary process technologies available to develop microchannel cooling concepts with 3D TSV interconnects and printed antennas.

Project Partner IMB-CNM (CSIC)

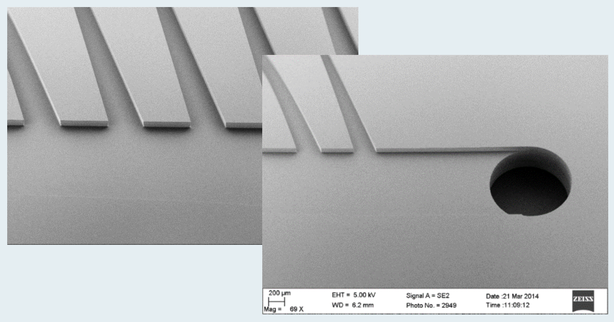
CSIC will contribute to the APECS-PL by

- Development of sensors and/or ASICs and methods to integrate the microchannel cooling
- High-resolution additive manufacturing (AM) based on piezo-inkjet or super-fine inkjet and extrusion-based additive manufacturing
- Laser- and plasma-based surface treatment technologies to improve isotropy and structural resolution

The R&D activity of IMB-CNM (CSIC) is in layout design, simulation, fabrication and characterization of semiconductor radiation sensors and microelectronics devices. In addition, they have started using 3D printing for various electronic applications.

Project Partner Fraunhofer IZM

Fraunhofer IZM stands for application-oriented, industry-related research. The well-established wafer level pilot-line can be utilized for prototyping and small volume production with technologies like wafer level bumping, wafer level CSP and redistribution, 2.5D / 3D integration, flip-chip assembly, or MEMS integration. It also offers high flexibility regarding wafer sizes from 100 mm to 300 mm. For antennas Fraunhofer IZM has a focus on the optimized design and characterization of RF/millimeter-wave radar modules using the M3 approach (methods, models, measures).



Cooling microchannels (left) and coolant I/O hole (right)
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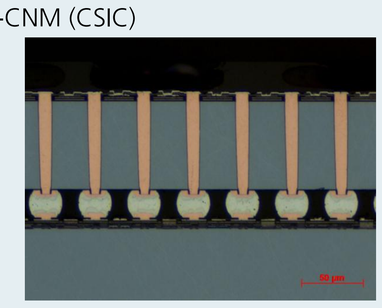
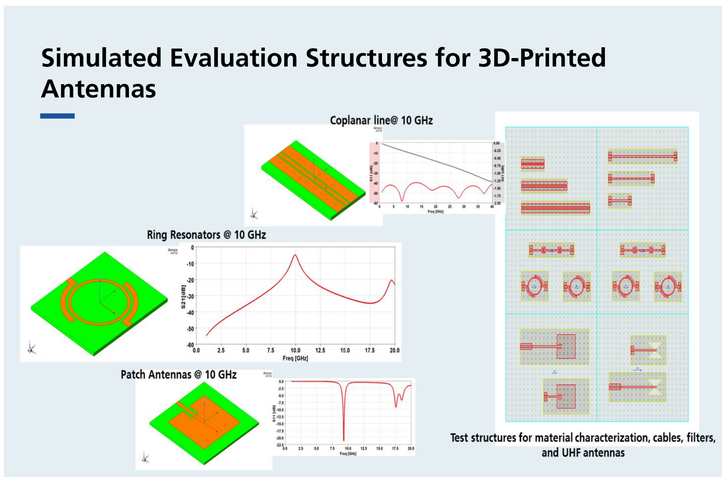


Through Silicon Vias (TSV) in SPAD sensor array
© Fraunhofer IZM



Microchannel Cooling

The trend towards higher packaging density demands innovative cooling concepts to solve challenges related to the thermal management of electronic devices. Active micro-channel cooling, either as a cooling interposer or monolithically integrated, can help to reduce the operating temperature of high power processor chips as well as homogenize the temperature over large area sensor devices. The goal of the joint project is the combination of microchannel cooling and TSV technology in one demonstrator platform.

Objectives

Technological alternatives incorporating microchannel cooling for heterogeneous integration make use of functional interposers. This technology is useful for high-density heat removal and for cooling large-area sensors that require a uniform temperature distribution, such as imaging sensors. The interposer platform will be developed in two phases. In the first project phase, different technology aspects will be developed through individual pathfinding steps. In the second project phase, these process blocks will be combined to manufacture the 3D microchannel interposer.

Applications

3D interposer with microchannels for thermal management in:

- High energy physics
- Photon science
- High performance computing

Printed Antennas

Printed antennas are promising alternative to complex plating technologies. Various printing technologies, like screen printing, inkjet printing, super-fine inkjet and 3D printing to produce cost-effective and customizable solutions are under development. These developments can be based on using sustainable/eco-friendly substrates, including flexible and conformable substrates, opening up opportunities for integration into flexible and unconventional electronic systems. The use of sustainable or eco-friendly substrates and conductive inks derived from renewable resources can further minimize the environmental footprint. This approach holds particular significance in advancing disposable, single-use, or transient systems. Also, 3D Additive manufacturing techniques facilitate the creation of antennas with complex geometries, optimizing their performance. This method opens up new possibilities for antenna design, especially in compact and unconventional spaces. This will allow the design freedom known from AM including creating circuitry in conjunction with 3D substrates to pursue an integrated hybrid-process including 3D antennas, free-formed circuits integrating thinned silicon chips and passives. This plays a pivotal role in enhancing the efficiency and sustainability of such systems, emphasizing their temporary nature while optimizing their performance and minimizing environmental impact.

The current facilities at IMB-CNM (CSIC) support the printing of antennas and systems on flat surfaces using techniques such as screen printing, inkjet printing, and gravure.

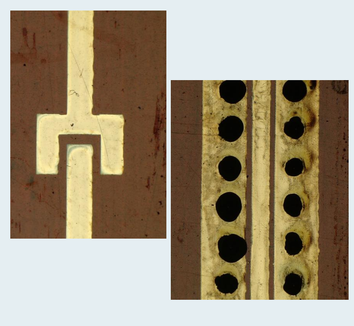
Objectives

Antennas are critical components in modern communication systems, serving as the primary radiating elements. While two-dimensional antennas have become standard, the evolution towards three-dimensional designs is rapidly progressing. The objective is to develop two types of antennas using additive manufacturing: flexible and 3D-printed antennas. IMB-CNM will fabricate UHF antennas and use the experimental results to establish design guidelines for optimizing antenna geometries at different frequencies.

Applications

3D and Flexible Antennas for:

- Bluetooth, WLAN
- Sensor Networks
- 5G Communication
- Radar Applications



Inkjet-Printed Silver UHF Antenna on a Flexible Substrate
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Joint Technology Development

CNM Centre Nacional de Microelectrònica IMB CSIC Consejo Superior de Investigaciones Científicas

Fraunhofer IZM

Contact

Luis Fonseca & Javier Fernández-Tejero
Institute of Microelectronics of Barcelona (IMB-CNM, CSIC)
E-Mail: luis.fonseca@csic.es
E-Mail: javier.fernandez@csic.es

Thomas Fritzsch & Christian Tschoban
Fraunhofer IZM
E-Mail: Thomas.fritzsch@izm.fraunhofer.de
E-Mail: Christian.Tschoban@izm.fraunhofer.de
www.apecs.eu | info@apecs.eu

Additional information

The work presented was carried out in the framework of the APECS Pilot Line of the Chips Joint Undertaking, funded by Horizon Europe and Digital Europe Programmes and national funding authorities of Austria, Belgium, Finland, France, Germany, Greece, Portugal, Spain.

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Co-funded by the European Union