

Contributions to the APECS Pilot Line: Ferdinand-Braun-Institut (FBH)

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Ferdinand-Braun-Institut (FBH) is one of 14 German research institutes involved in the implementation of the APECS pilot line and one of the two Leibniz institutes within the Research Fab Microelectronics Germany (FMD). FBH has extensive expertise in high-frequency electronics, photonics, and quantum technologies, based on III-V semiconductors. Its industry-compatible process lines facilitate access for industrial and research partners and transfer to applications.

In electronics, researchers at FBH develop high-efficiency, multifunctional microwave power amplifiers and millimeter-wave transceivers for energy-efficient wireless communications, radar, industrial sensing, and imaging. In photonics, the focus is on advanced light sources from the near-infrared to the ultraviolet, including high-power diode lasers, UV light sources, and hybrid laser modules. Applications range from medical technology and high-precision metrology to space-based optical communications and quantum technologies.

The role of FBH in the APECS pilot line

- FBH complements the APECS pilot line portfolio by providing the design and fabrication capabilities for dedicated III-V chiplets, which form key technology enablers for RF and optoelectronic applications.
- In RF, III-V semiconductors allow boosting output power at high frequencies and to realize ultra-broadband functions, exceeding the limits of the BiCMOS components. This is required for broadband wireless point-to-point communication above 100 GHz, where indium phosphide (InP) offers higher output power, which translates into increased range. On the other hand, bipolar InP circuits enable ultra-high bandwidth in electro-optical transceivers. Integrating InP functionality with BiCMOS in a seamless environment is essential to leverage these performance benefits in practical systems.
- In photonics, FBH addresses laser diodes based on gallium arsenide (GaAs), which cover the wavelength range from around 620 nm to 1180 nm. A chiplet approach with optical interposers is used to realize compact photonic integrated circuits in this wavelength range.

Thus, the chiplet platforms at FBH and their integration options with silicon-based processes form an indispensable part of the APECS pilot-line offering, providing access to high-performance RF and optoelectronic solutions not available elsewhere in Europe.

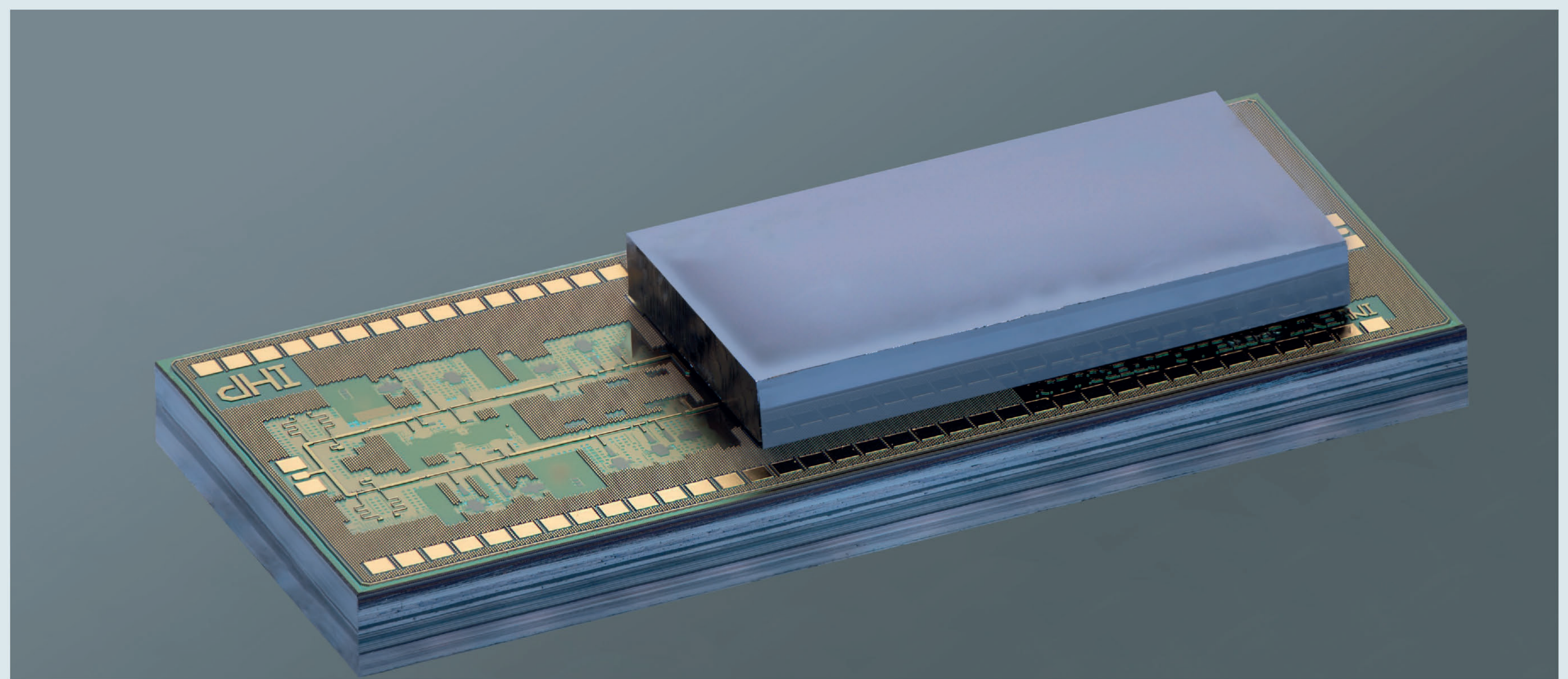
Heterogeneously integrated InP-based transimpedance amplifier (TIA) on a photo diode receiver using FBH's heterogeneous integration process. The complete system offers broadband operation from DC up to 80 GHz.

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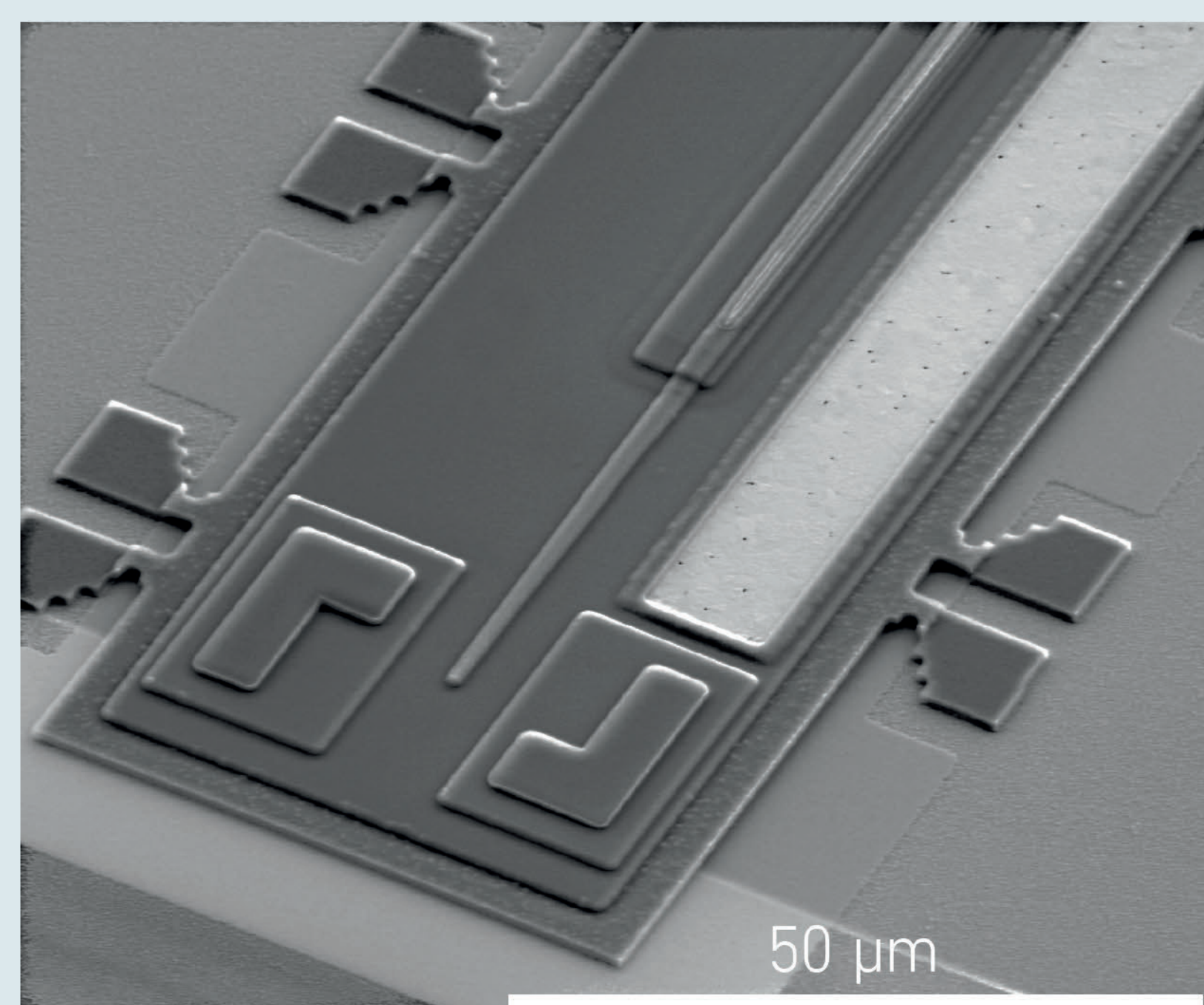
Heterogeneously integrated InP power amplifier and switch on SiGe-BiCMOS transceiver

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GaAs gain chiplet hanging freely on anchors prior to microtransfer printing

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What is APECS?

APECS (Advanced Packaging and Heterogeneous Integration for Electronic Components and Systems) is one of 5 European pilot lines established under the EU Chips Act. APECS is the foundation for Europe's competitive position in heterogeneous system integration and advanced packaging. It plays a vital role in enhancing Europe's strategic autonomy by reducing dependence on foreign suppliers and strengthening Europe's capabilities in critical technology areas.

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Contributions to the APECS pilot line

FBH is strengthening the APECS technological portfolio in two key areas: bipolar chiplets for mm-wave applications in the W- and D-bands based on indium phosphide (InP) and laser chiplets based on gallium arsenide (GaAs). Specifically, FBH contributes through:

- Developing a platform for InP-HBT chiplets integrated on SiGe-BiCMOS from Leibniz IHP. This enables hetero-integrated high-performance transceivers and broadband circuits for RF frequencies up to D-band, supported by a dedicated ADK (Assembly Design Kit)
- Establishing a platform that enables the integration of GaAs-based laser-diode chiplets (wavelength range from 620 nm to 1180 nm) with other components on optical carriers (photonic integrated circuits – PICs)

Additional information

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