Speaker name: **Tanja Braun**
Organization: **Fraunhofer IZM**
Country: **Germany**
Speaker picture:

Presentation title: **Advanced Packaging Solutions for mmWave Applications**

SHORT ABSTRACT OF PRESENTATION

With the end of Moore's law, advanced packaging and heterogeneous system integration is gaining more importance. At the same time in the last years, the increasing demand for ever higher data rates in wireless communication has exposed the limits of current sub-6 GHz communication systems and pushed the technology toward the exploration of the millimeter-wave (mmWave) frequency spectrum. In particular, three frequency bands have been licensed at 26, 28, and 39 GHz for the new generation of mobile communication (5G), each exhibiting as much as 3 GHz of operational bandwidth. However, systems operating at mmWave must cope with much higher free space losses than in the sub-6 GHz frequency range. Moreover, the physical size of interconnects (chip-to-chip, chip-to-antenna) becomes comparable to the operating wavelength. Therefore, new packaging technologies are required, which allow implementing large antenna arrays for massive MIMO and short interconnects to minimize package losses. Radar systems working at 77 GHz for, e.g., autonomous driving have also entered the market. All these new applications also require new packaging solutions allowing higher manufacturing volume and lower cost.

Advanced packaging solutions suitable for RF and mmWave applications are, e.g., flip chip and interposer solutions, fan-out wafer level packaging (FOWLP), or chiplet approaches. This also addresses topics such as antenna-in-package solutions, shielding on package level, passive component integration, or heterogeneous integration of III/V semiconductors with Si or SiGe in one package.

From the above-mentioned technologies, FOWLP is currently one of the strongest trends in microelectronics packaging. FOWLP has a high potential in

significant package miniaturization concerning package volume but also in thickness reduction. The main advantages of FOWLP are the substrate-less package, low thermal resistance, and high RF performance due to shorter interconnects. Especially inductance of FOWLP is much lower compared to FC-BGA (Flip Chip Ball Grid Array) packages. In addition, the redistribution layer can also integrate embedded passives (R, L, and C) as well as antenna structures using a multi-layer structure. It can be used for multi-chip packages for system in package, package stacking, and heterogeneous integration. Hence, technology is well suited for RF applications.

FOWLP is applied for volume production for mobile and wireless applications (mainly wireless baseband) and has meanwhile been introduced in automotive applications. Infineon started with a 77 GHz Radar IC Chip Set being the first 77 GHz solution based on FOWLP eWLB (embedded Wafer Level Ball Grid Array) instead of a bare die. As the technology offers a lot of opportunities for RF packaging with shortest interconnect lengths and the possibility of integrating passive components and even antenna structures, more applications will enter the market, especially with the advent of 5G and 6G applications.

KEYWORDS

Advanced packaging, antenna-in-package, fan-out wafer level packaging.

BIOGRAPHY

Tanja Braun studied mechanical engineering at Technical University of Berlin with a focus on polymers and micro systems and joined Fraunhofer IZM in 1999. In 2013, she received her Dr. degree from the Technical University of Berlin. Tanja Braun is head of the department of System Integration and Interconnection Technologies. Her recent research is focused on fan-out wafer and panel level packaging technologies. In 2021, she received the Exceptional Technical Achievement Award from IEEE Electronics Packaging Society (EPS) and the IMAPS Sidney J. Stein Award for her work in the field of fan-out wafer and panel level packaging. Tanja Braun is an active member of IEEE. She is a member of the IEEE EPS Board of Governor (BOG) and is the IEEE EPS VP of Conferences.