

7. Fundamentals of RF Design and Fabrication Processes of Advanced Packages including Fan-Out, Chiplets, Glass and Polymer Interposers

Course Leader: Ivan Ndip – Brandenburg University of Technology/Fraunhofer IZM and Markus Wöhrmann – Fraunhofer IZM

Course Description:

Advanced packaging technologies such as fan-out wafer and panel level packages (FO-WLPs, FO-PLPs), interposers (e.g., glass interposers with TGVs, polymer interposers) and chip-embedding packages (e.g., PCB embedding) play a key role in heterogeneous integration and enable the development of system in package (SiP) modules, antenna-in/on-package (AiP/AoP) and chiplet based systems. The packaging materials, fabrication processes and RF performance of these packages contribute significantly to the cost, performance and reliability of the entire system.

The main objective of this course is to provide a thorough overview of packaging materials, fundamentals of fabrication processes and basic RF design of advanced packages (e.g., fan-out wafer/panel level packages, glass and polymer interposers, SiP and AiP/AoP) for a wide range of applications. Furthermore, an introduction to chiplet design and heterogeneous integration, considering interconnects for chiplet communication and UCIe, will be given. The applications driving advanced packages such as 5G, 6G communication, radar sensing, high-performance computing (HPC) and AI in various industries will also be extensively discussed.

Course Outline:

1. Introduction, Basic Definitions and Explanations of Key Terminologies Related to Advanced Packages, RF Design, Chiplets and Heterogeneous Integration
2. Applications Driving Advanced Packages such as 5G, 6G Communication, Radar Sensing, HPC and AI in Various Industries
3. Overview of Different Types of Advanced Packages, Current Trends and Future Directions
4. Challenges and Key Requirements of Advanced Packages for RF Applications
5. Fundamentals of Packaging Materials and Fabrication Processes of Fan-out Wafer/panel Level Packages, Interposers (Glass, Organic) and AiP/AoP
6. Role of Electrical Parameters (D_k and D_f) of Materials in RF Packaging and Methods for Measurement-based Extraction of D_k and D_f of Different Packaging Materials
7. Fundamentals of RF design of Building Blocks of Fan-out Wafer/panel Level Packages, Interposers (Glass, Organic) and AiP/AoP
8. Introduction to Chiplet Design and Heterogeneous Integration, Considering Interconnects for Lateral Chiplet Communication and UCIe
9. Examples of Advanced Packages Fabricated at Fraunhofer IZM

Who Should Attend:

Engineers, scientists, researchers, designers, managers, graduate students and business developers interested in the fundamentals of electronic packages and chiplets as well as those involved in the process of electrical design, layout, fabrication and/or system-integration of electronic packages and chiplets for emerging applications.

Bio 1: Ivan Ndip is a full Professor at the Brandenburg University of Technology (BTU) in Germany. He is also with Fraunhofer IZM, where he has been working since 2000. At IZM, he currently leads the Department of RF & Smart Sensor Systems in Berlin and the IZM Branch

Lab for High-Frequency Sensors and High-Speed Systems in Cottbus. While working at IZM, he also served as a Lecturer at the Technische Universität (TU) Berlin from 2008 to 2019.

Ivan has been teaching Professional Development Courses (PDCs) to practicing engineers and scientist worldwide since 2008. He is the author and co-author of more than 250 publications in referred journals and conference proceedings, and has more than 35 German, European and US patents. His research has been honored with numerous national and international awards.

Ivan studied electrical engineering and obtained his Dipl.-Ing. (M.Sc.), and Dr.-Ing. (PhD) with the highest distinction (summa cum laude), in 2002 and 2006 respectively from TU Berlin. In 2017, he received his second doctorate degree, Dr.-Ing. habil., also in electrical engineering from BTU Cottbus-Senftenberg. He served on the Executive Board of IMAPS as Director from 2016 to 2020. He is a Fellow and Life Member of IMAPS as well as a Senior Member of IEEE.

Bio 2: Markus Wöhrmann received the M.Sc. electrical engineering at Technical University of Berlin in 2010. Since 2010 he is working on electrical and mechanical property estimation of thin film layers at the Technical University of Berlin. In 2016 he joined the Fraunhofer Institute for Reliability and Microintegration (IZM). He leads the group “Lithography and Thin Film Polymers for Wafer-Level-Packaging” at the Fraunhofer IZM since 2019, where he is responsible for process development of RDL processing for Fan-In and Fan-Out Wafer Level Packaging.