3. Fundamentals of RF Design and Fabrication Processes of Fan-Out Wafer/Level and Advanced RF Packages

Course Leaders: Ivan Ndip and Markus Wöhrmann – Fraunhofer IZM

Course Description:

Due to their myriad of advantages in system-integration, fan-out wafer/panel level packages (FO WLPs/PLPs) and other advanced RF packages (e.g., glass interposers and chip-embedding packages) will play a key role in the development of emerging electronic systems. The fabrication processes and RF performance of these packages will contribute significantly to the cost and performance of the entire system. The objective of this course is to provide and illustrate the fundamentals of the fabrication processes and RF design of these advanced packages for emerging RF/wireless applications.

An overview of distinct types of wafer-level packages, fan-out technologies, glass interposers and chip-embedding packages will first be given. This will be followed by a presentation of new fan-out-packaging and interposer-based concepts for emerging and future applications (e.g., 5G mmWave, mmWave radar sensors, 6G) as well as a thorough discussion of the materials and fabrication processes of FO-WLPs/PLPs, multilayered RDLs, glass interposers and chip embedding packages. The basics of efficient RF design and measurement of the fundamental building blocks of these advanced packages will be given for frequencies up to the millimeter-wave range. Finally, examples of these advanced packages designed and fabricated at Fraunhofer IZM will be discussed.

Course Outline:

1. Overview: Different Types of Wafer-Level Packages, Fan-out Technologies, and Advanced RF Packages
2. Requirements of 5G Packaging and New Fan-out Packaging Concepts for 5G mmWave Applications
3. Materials and Fabrication Processes: FO-WLPs/PLPs, Multi-layered RDLs, Glass Interposers and Chip Embedding Packages
4. Fundamentals of RF Design and Measurement: FO-WLPs/PLPs, Glass Interposers and Chip-Embedding Packages
5. Examples of Advanced Packages Designed and Fabricated at Fraunhofer IZM

Who Should Attend:

Engineers, scientists, researchers, designers, managers, and graduate students interested in the fundamentals of electronic packaging as well as those involved in the process of electrical design, layout, processing, fabrication and/or system-integration of electronic packages for emerging applications (e.g., 5G, 6G, mmwave radar sensors) should attend.

Ivan Ndip has been with Fraunhofer IZM for over 20 years, where he currently leads the Department of RF & Smart Sensor Systems. He also leads the Fraunhofer IZM Branch Lab for High-Frequency Sensors & High-Speed Systems in Cottbus.
Ivan taught graduate courses in the Faculty of Electrical Engineering and Computer Sciences at the Technische Univerisitaet Berlin for 10 years. He has been teaching Professional Development Courses (PDCs) to practicing engineers and scientist worldwide for over 11 years. He has authored and co-authored over 220 scientific publications in peer-reviewed journals and conference proceedings as well as over 35 German, European and US patents. He has won numerous best paper, national and international awards.
Ivan received the Dipl.-Ing. (M.Sc.) and Dr.-Ing. (Ph.D.) degrees in electrical engineering from the Technische Universitaet Berlin, and the Dr.-Ing. habil. degree also in electrical engineering

from the Brandenburg University of Technology, Cottbus-Senftenberg, Germany. He served as Director in the IMAPS Executive Council from 2016 to 2020. He is a Life Member and Fellow of IMAPS as well as Senior Member of IEEE.

Markus Wöhrmann did graduate work on the material properties of polymers in packaging at the Technische Universität Berlin and received the M.Sc. in electrical engineering in 2010. Since 2010 he is working on electrical and mechanical property estimation of thin film layers at the Technische Universität Berlin in cooperation with the Fraunhofer Institute for Reliability and Microintegration (IZM). He is leading the glass interposer technology development at the Fraunhofer IZM since 2012 and he works in the group "Lithography and Thin Film Polymers" at the Fraunhofer IZM on the process development of RDL processing for Fan-Out Wafer Level Packaging.