Integrating advanced multimodal microscopy and artificial intelligence solutions for failure analysis in electronics and semiconductors

Flavio Cognigni[a], Domenico Mello[b], Heiko Stegmann[c], Anton du Plessis[d], Philippe Von Gunten[b], Guillaume Fiannaca[b], Marco Rossi[e] and Giulio Lamedica[a]

[a] *Carl Zeiss SpA, Milan, Italy*
[b] *EM Microelectronic, a Company of the Swatch Group, Marin, Switzerland*
[c] *Carl Zeiss Microscopy GmbH, Oberkochen, Germany*
[d] *Comet Technologies, Montreal, Canada*
[e] *Sapienza University of Rome, Italy*

In semiconductor manufacturing, the process of laser dicing can result in a loss of yield due to defects associated to the laser interaction with the sample. These defects can be difficult to identify, especially before a proper tuning of the process. Traditional investigation methods, like infrared (IR) inspection and focused-ion beam scanning electron microscopy (FIB-SEM) analysis, are labor-intensive and lack comprehensive insights. Here, we propose a robust correlative microscopy (CM) workflow integrating IR, X-ray Microscopy (XRM), and FIB-SEM tomography analyses, leveraging artificial intelligence (AI) driven algorithm for time- and quality-improved dataset reconstruction, automatic segmentation and defect site identification. Our approach streamlines defect identification, preparation, and characterization. Through AI-enhanced methodologies, as well as femtosecond (fs) laser, we optimize investigation efficiency and extract crucial information about defects properties and evolution. Our research aims to advance semiconductor failure analysis by integrating AI for enhanced defect localization and high-quality 3D dataset acquisition in the realm of laser dicing processes.