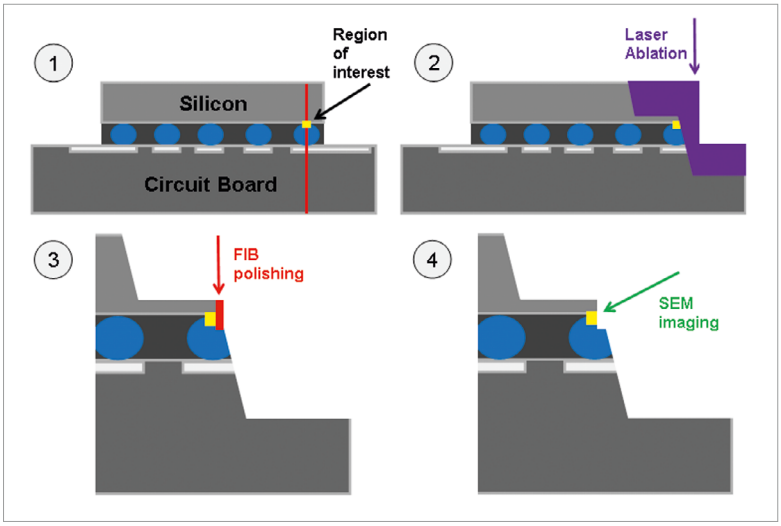
AURIGA® Laser: Efficient and precise sample preparation by combination of pulsed laser ablation and FIB milling

R. Salzer[1], I. Schulmeyer[1], H. Stegmann[1] and K. Tsyrulin[1]
[1]Carl Zeiss Microscopy GmbH, Carl-Zeiss-Str. 22, 73447 Oberkochen, ingo.schulmeyer@zeiss.com

Today, sample preparation for electron microscopy more often than ever requires the removal of large amounts of material e.g. to access deeply buried sample structures. Until now, such preparation has been achieved using demanding and slow techniques, such as metallographic cross sectioning and ion polishing, or FIB milling. Carl Zeiss has overcome this challenge by combining a pulsed ns-laser with an Auriga CrossBeam® FIB/SEM system. This allows precise target preparation of deeply buried features in a much more efficient way. The Laser system is attached to the load-lock chamber in order to avoid contamination of high voltage parts in the main chamber by laser sputtered material. The ablation of material volumes in the order of several 10 mm^3 can be performed within minutes, followed by FIB preparation and SEM analysis in the same instrument [1,2,3]. This new approach allows a time efficient target I ampreparation with high positioning accuracy of deeply buried structures and of extremely large cross sections.

Laser-cut cross-sections usually leave a roughness of a few µm, making them unusable for direct imaging. Also the targeting precision that is needed can not be achieved by a standalone laser system. In the combined system the precise material removal capability of FIB allows target preparation with nanometer precision.

With the new Auriga® Laser ablation at the region of interest with high positioning accuracy [1] is performed within minutes, followed by FIB preparation and SEM imaging and analysis in the same instrument. The feasibility of ablating different materials in 3D integrated devices with such a laser resulting in a surface roughness of around 5 µm has recently been demonstrated [3]. The heat affected zone was shown to be limited to the order of the surface roughness [4]. That the laser FIB/SEM combination is capable to quickly expose deeply buried features in microelectronic devices in one workflow has been published [1,2,4]. Furthermore, to prepare large cross sections in brittle or soft materials can be very demanding and often conventional methods are not applicable. The feasibility of using laser cutting on these materials to get access to large cross sections for further FIB/SEM investigations has been presented also [5]. In addition, the ability to remove large arbitrary structures enables a wide field of novel sample preparation procedures. This contribution will feature examples from several application areas, such as interconnect technologies for 3D IC integration, photovoltaics, packaging, geological and biomedical structures.



1. M. Petzold et al., Proc. 60th Electronic Compon. and Technol. Conf. (ECTC) (2010) 1296.
2. S. Martens et al., PhD Thesis, MEMS Technology and Engineering 16, IMTEK (2011)
3. H. Stegmann et al., Microsc. Microanal. 17 (2011).
3. S. Martens et al., ASME J. Electronic Packaging 131(3) (2009), p. 1.4.
4. S. Martens et al., Proc. 11th Int. EuroSimE Conf. (2010), p. 1.