

Focused Ion Beam Technology A Route To Silicon Nanofabrication

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Focused ion beam (FIB) technology is an attractive tool for maskless patterning processes enabling microstructure fabrication far below 50 nm. The current state of the art covers a wide variety of activities, ranging from pure analytical applications for SEM and TEM, up to constructive formation of nanostructures comprising deposition, modification, and etching of metals, semiconductors, and dielectrics. Beyond applications in high volume microelectronic fabrication processes, FIB has a great potential in more limited applications such as explorative prototype construction and high end specialty devices on a nanometric scale.

The Institute of Solid State Electronics of the TU-Vienna has started a focused ion beam program dedicated to the use of these techniques to investigate the basic physics, technology, and applications of explorative structures and prototypic devices with dimensions in the sub 50 nm regime, which are key elements in high risk microelectronic developments. The objectives are (i) exploration of ion assisted processes for deposition and selective removal of electronic materials, (ii) testing and proof of new concepts for key process modules in the sub 100 nm microelectronic process regime, (iii) defect analysis of electronic devices in the submicron range, (iv) circuit modification on the wiring level for evaluation and rapid prototyping of new circuit concepts. A further issue is the development of new types of sensor heads, enabling nanoscale metrology.

According to our main activities in the field, we report on concepts and recent results regarding ion beam interaction with active silicon devices, device engineering by sublithographic channel implants for sub 100 nm MOS-devices, circuit defect diagnosis, and sample preparation for TEM analysis. The integration of an ultramicroelectrode in an AFM cantilever allowing a complete separation of the topological and the electrochemical information is an issue in nanoelectronic device construction.