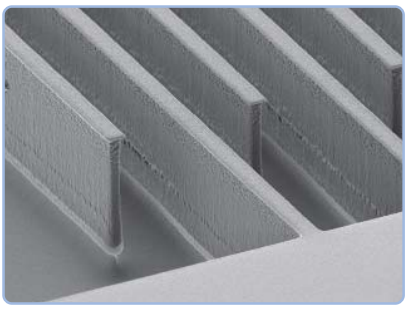
Research activities on Si Micromachining

Laboratory of Microsensor Structures (LMSE) is involved in research and development of silicon devices, sensors and microelectromechanical systems (MEMS). Internal properties and external characteristics of semiconductor devices are studied using analytical and computer modeling. Semiconductor process technology available in LMS allows investigations of basic semiconductor processes (mask design and fabrication, photolithography, diffusion, depositions, cleaning, etching, micromachining etc.) and development of active and passive discrete semiconductor devices (photosensors, pressure sensors, temperature sensors, radiation sensors, sensors for nuclear physics, 3D structures etc.). Technological research is supported by measurement equipment and characterization techniques, aided by process and device modeling.

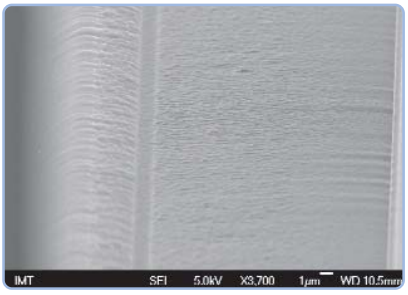
LMS offers complete research and development services in the field of silicon semiconductor devices and MEMS, from theoretical analysis to development of test structures and devices, their characterization and optimization. Partial R&D services are also available such as modeling (process & device simulation), characterization (various measurements and testing), single semiconductor processing steps development (lithography, diffusion, metalization, depositions, micromachining etc.) and similar.

Latest results: ***Thin Fluorocarbon Films for Sidewall Passivation in SCREAM Process for MEMS***

Thin fluorocarbon (FC) films were introduced as a replacement for PECVD silicon oxide for sidewall passivation in SCREAM process for MEMS. The main advantage of using fluorocarbon thin film in this process for passivation is that the passivation film is grown in the same system as all other process steps are made. Therefore, the whole process can be done in one step (one-step-one-run process) so that the system (standard capacitive coupled RIE etcher-PLASMALAB μP 80 from Plasma Technology, UK) does not need any changes. The applied FC film conformably covers the sidewalls of high-aspect-ratio (HAR) micro-structures and sustains the release etches of a beam. By a proper set of process parameters it is possible to control the properties of deposited thin FC films within a certain range, e.g. changing the coverage from unidirectional to conformal, and at the outermost process condition, it is possible to change the deposition to unidirectional etching of FC film.



SEM micrograph of comb structure, showing 4 μm width and 21 μm thick released beams suspended over the etched bottom floor. 850 nm thick FC film was deposited at RF power of 90 W, pressure of 400 mtorr. CHF3 gas flow rate is 40 sccm



SEM image of the beam sidewall surface passivated by FC thin film.

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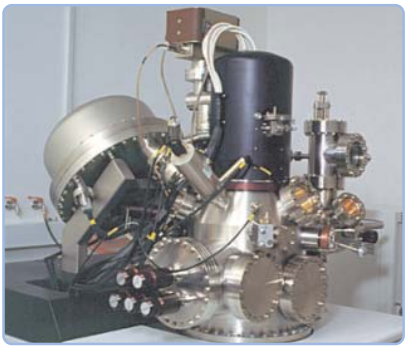
Laboratory for the Surface Characterization of Materials

The laboratory belongs to the *Department of Surface engineering and applied surface science* from the **Institute of metals and technology (IMT, web: http://www.imt.si/), Slovenia.** The main research activities are research and characterization of solid surfaces, boundaries, surfaces of grains and phases, the analysis of microstructures and submicron features; research into physical-chemical phenomena on the free surfaces of metallic and inorganic materials: adsorption, segregation of surface-active elements, oxidation, corrosion, recrystallization, wear, catalysis and analysis of thin and ultra-thin films.

Employed characterization techniques: *• High-Resolution Auger-Electron Spectroscopy (HRAES); • Scanning Auger-Electron Microscopy (SAM); • Scanning Electron Microscopy (SEM); • X-ray Photoelectron Spectroscopy (XPS); • Reflected-Electron Energy-Loss Spectroscopy (REELS).*

Specific research topics: *• research, development and optimization of the manufacturing of soft magnetic materials and electrical steel sheets; • characterization of submicron carbide precipitates in steels and iron based alloys; • investigation of the surfaces of metals covered by metallic or non-metallic films by means of "in-situ" analysis and measurements in ultra high vacuum at temperatures of up to 1000 °C; • research into the interactions of the gas phase and the solid surface of materials; • characterization of thin and ultra-thin films; • characterization of surfaces after tribological testing; • magnetic measurement of soft-magnetic materials.*

International co-operation: *• MPI Max-Planck-Institut für Eisaenforschung, Düsseldorf, Germany; • NIST – National Institute of Standards and Technology – Gaithersburg, ML, USA; • Institut za fiziku, Sveuèilišta u Zagrebu, Zagreb, Hrvatska.*



VG-Scientific Microlab 310F with AES, SAM, SEM, XPS and in situ fracturing device

Information source: ***http://www.imt.si/index.php?id1=2&id2=2&id3=1&lang=en***

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