


„We support research activities in Slovakia/Project is cofinanced from EU sources“

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Information about research infrastructure and offer for collaboration

Company Integra TDS, s.r.o., Pod Párovcami 4757/25, 921 01 Piešťany, Slovakia would like to inform interested community, that realizing project cofinanced by EU and Slovak republic and entitled: “Research and development centre for advanced X-ray technologies” the company enlarged technical park for its research and production by modern infrastructure, mainly by new technology for surface processing of materials, as well as by X-ray techniques for their characterization.

Nanomachining centre Nanotech 350 FG

Machining possibilities and techniques provided by new Nanomachining centre 350 FG (Fig. 1) from Moore Nanotechnology Systems (Nanotech, USA), which is used for research of X-ray optics, enable us to achieve high quality of surfaces of various shapes with nanometer range of precision in the so called ductile regime without microcracks. These techniques include:

SPDT – single point diamond turning,
raster flycutting,
SSS – slow slide servo turning,
linear grooving (ruling),
micro milling.

For more details see: <http://www.nanotechsys.com/machines/nanotech-350fg-freeform-generator/>.



Obr. 1. Nanomachining centre Nanotech 350 FG.

Nanotech® 350FG Specifications

Capacity

Travel in X 350 mm
Travel in Y 150 mm
Travel in Z 300 mm
Travel in B and C (Optional) 360 degrees
Maximum Swing Capacity 500 mm (20 in.)

Speeds and Feeds and

Traverse Speed: X, Y, & Z 2000 mm/min
Spindle 10,000 rpm
C-axis 3,000 rpm
Optional B-axis 50 rpm

Accuracy

X, Y, & Z Horizontal Straightness $\leq 0.3 \mu\text{m}$
Spindle Axial & Radial Error Motions $\leq 12.5 \text{ nm}$
B-axis Axial & Radial Error Motions $\leq 100 \text{ nm}$
Geometric Squareness $\leq 2 \text{ arc sec}$
Form Accuracy $\leq 0.15 \mu\text{m}$
over 75 mm dia.
Surface Finish $\leq 3.0 \text{ nm Ra}$

Using the above technologies we prepare mainly the active surfaces of X-ray crystal optics. Contrarily to classical optics a regular surface waviness with P/V value of several nanometers can negatively influence mainly the imaging properties of X-ray optics, which is the motivation of our effort within the project to minimize it.

Fig. 2 compares by AFM germanium surfaces prepared by chemical polishing and by SPDT. While P/V difference is similar for short distances – 6 nm at 10 μm, at 1500 μm it is 140 nm for chemical polishing and 25 nm for SPDT. Such extremely precise shapes of processed surfaces are the main advantage of nanomachining. At present we are trying to further decrease 6 nm surface waviness.

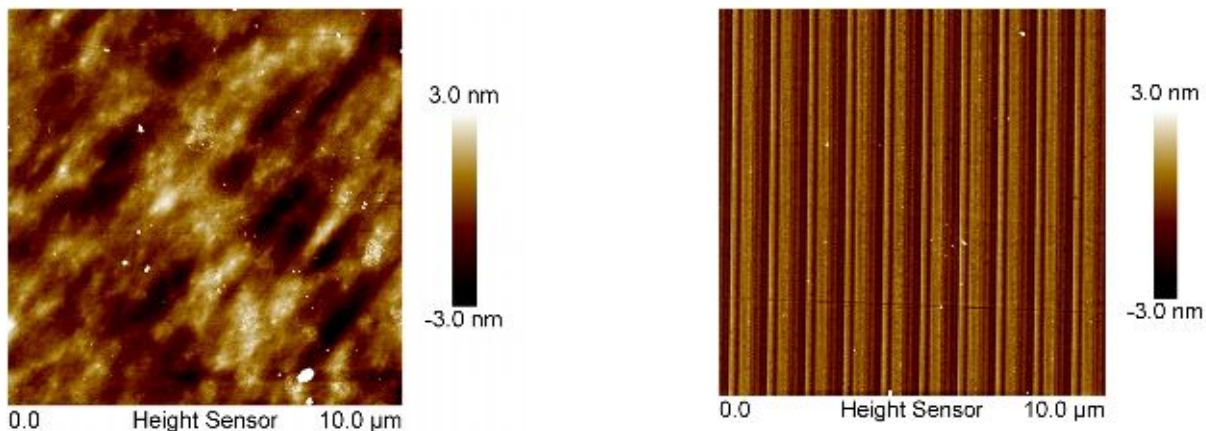


Fig. 2. Surface roughness by AFM. a) at surface Ge(110) after chemical final polish, b) at surface Ge(110) processed by SPDT.

Water purifier

For sample preparation, analyses, and finishing operations highly pure chemicals and water are a must. In chemical laboratory a low capacity equipment for modification of tapped water into ultrapure water in semiconductor quality was installed. The capacity is 3 l/hour and water specific resistivity at room temperature >18 MΩcm.

High resolution X-ray diffractometer D8 DISCOVER

The other important equipment is new High resolution X-ray diffractometer Bruker AXS D8 Discover (Fig. 3) to be used for surface quality evaluation by means of reflectometry and diffractometry, including reciprocal space mapping. Additionally, it allows high precision composition measurements of bulk and surface samples, epitaxial and multilayer structures and nanostructures. In X-ray laboratory it is used to explore structural properties of surfaces for X-ray diffractive optics and to study designed and realized elements of X-ray optics. For further possible applications see: <http://www.bruker.com/products/x-ray-diffraction-and-elemental-analysis/x-ray-diffraction/d8-discover/overview.html>.

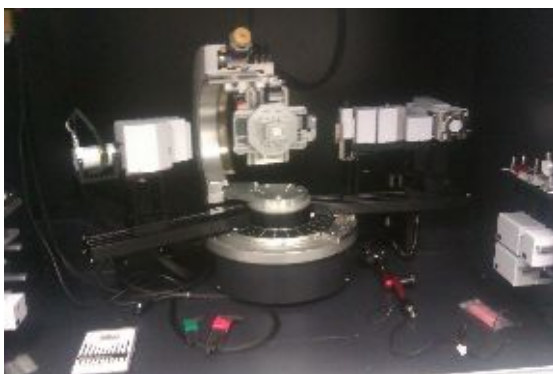


Fig. 3. X-ray diffractometer D8 DISCOVER.

The D8 DISCOVER is an all purpose X-ray analyzer which can be configured for all diffraction-based material research applications, including qualitative and quantitative phase analysis, structure analysis, high-resolution X-ray diffraction, reflectometry, reciprocal space mapping, grazing incidence diffraction (in-plane GID), grazing incidence small angle X-ray scattering (GISAXS), stress and texture analysis, and micro-diffraction, depending on accessories.

DAVINCI design

The D8 DISCOVER facilitates a new, pioneering plug & play diffractometer design for true plug & play operation, making the instrument ideal for changing needs, multiple user environments as well as high-end research: DAVINCI design.

- Extremely easy switch of all beam path components from the X-ray tube, through optics and sample stages to detectors
- Alignment- and tool-free change of optics (SNAP-LOCK)
- Foolproofness: Fully automatic component recognition with conflict detection and fully automatic instrument configuration.
- All purpose: Unparalleled adaptability to any conceivable X-ray powder diffraction application with one instrument

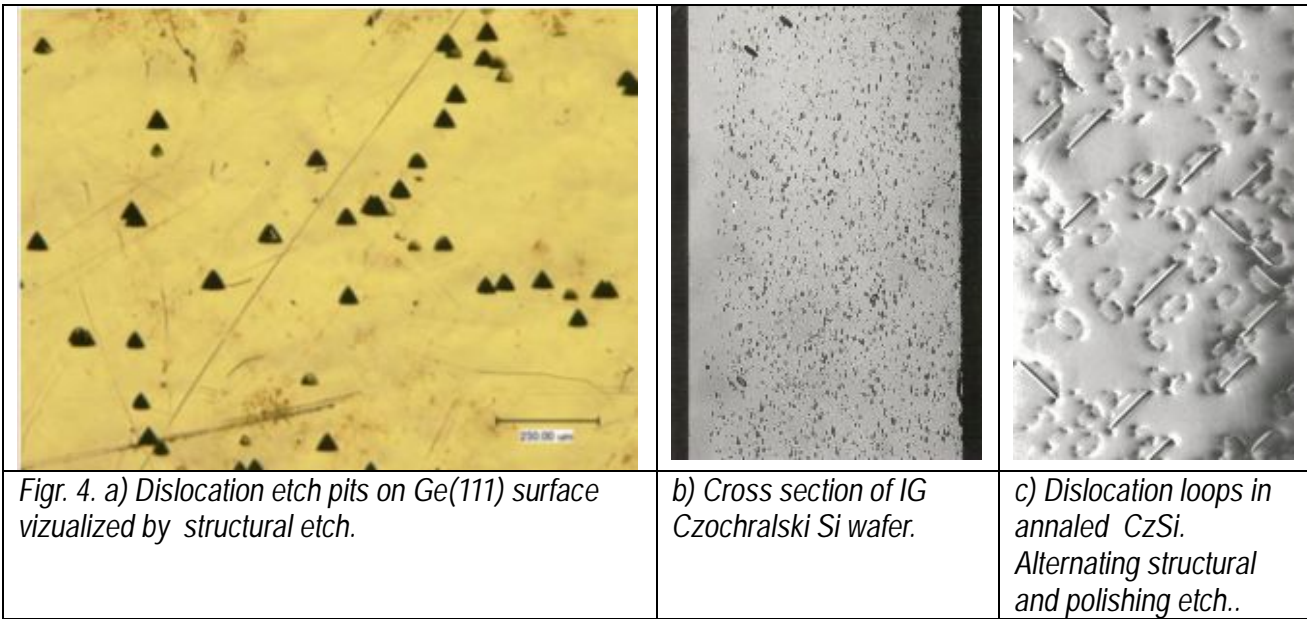
The D8 DISCOVER comes with the new DIFFRAC.SUITE software package. Its most outstanding feature is the DIFFRAC.DAVINCI plugin, the unique Virtual Goniometer software solution, showing all beam path components of the actual goniometer and their status. The automatic validation of the instrument configuration with real-time conflict detection provides for easy, intuitive, and fail-safe operation by any users, including novice users.

Elements and systems of X-ray crystal optics

We offer flat and channel-cut X-ray monochromators (symmetric, asymmetrical, compressors and expanders) made of germanium, silicon, copper, the so called imaging monochromators, reference samples, low scattering substrates, step by step also cylindrical, spherical and parabolic surfaces, optical prisms etc.. Standard and on-request special types both for laboratory and synchrotron applications. Some of them are shown in Gallery part at www.integratds.eu. In collaboration with partners we are able to propose, to test with simulating programs, and to realize special metrological and imaging systems.

Metallographical analyses

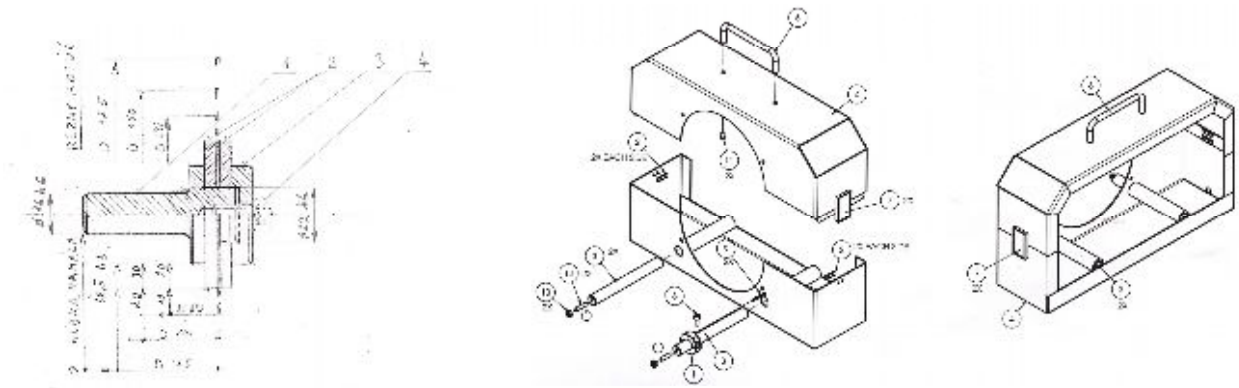
Analysis of the input material is given proper attention. In addition to collaboration in technology of surface processing the company offers other companies and research institutions also preparation of samples for metallography and analysis of crystal defects in semiconductors. Fig. 4 shows examples of dislocations in Ge(111), cross section of intrinsically gettered Cz Si wafer with near surface denuded zone and high density of bulk microdefects (dislocation loops and SiO₂ precipitates) under the denuded zone, and microdefects of annealed Cz Si visualized by a special technique of alternating structural and polishing etch.

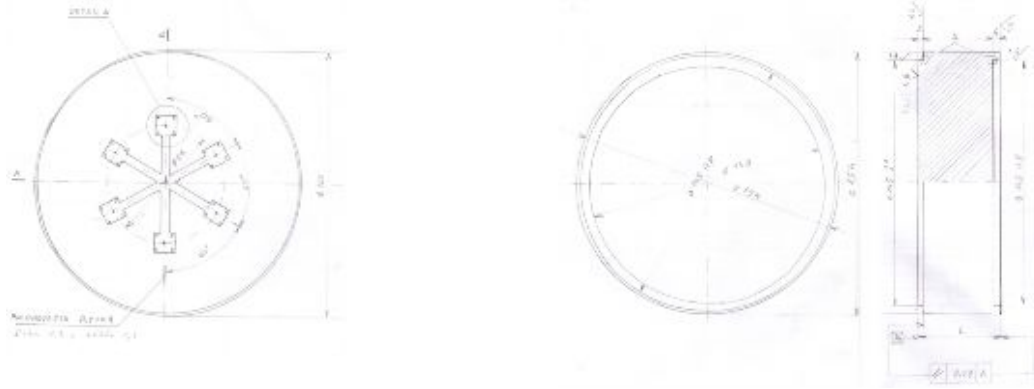


Special holders, tools, housings

Both for nanomachining centre and X-ray diffractometer a number of special sample and tool holders are necessary, Fig. 5 shows some of them. We are looking for companies to be able to deliver. Similarly, we are looking for collaboration in surface processing and X-ray analysis.

Fig. 5. Examples of needed tools and holders.





During project realization “Research and development centre for advanced X-ray technologies” was established with two research Institutes, Institute of Electrical Engineering (www.elu.sav.sk) and Institute of Physics (www.fu.sav.sk), Slovak Academy of Sciences, which have a common detached working place in Piešťany, Vrbovská cesta 110. Their research activities and infrastructure are presented at their webpages. Further location of project realization is in premises of Integra TDS, s.r.o. at Železničná 621/12 in Krakovany near Piešťany, Slovakia.

Because of long term experience in national and international research projects with our partners we are still interested in collaborations aimed at submitting proposals in relevant research, development and production areas, including Horizon 2020.

Integra TDS, s.r.o. Piešťany would like to thank visitors of webpage www.integratds.eu for their visit and would like to note that since December 15, 2013 a Contact point for industry and research institutions is in operation.

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[QUESTIONNAIRE](#)