

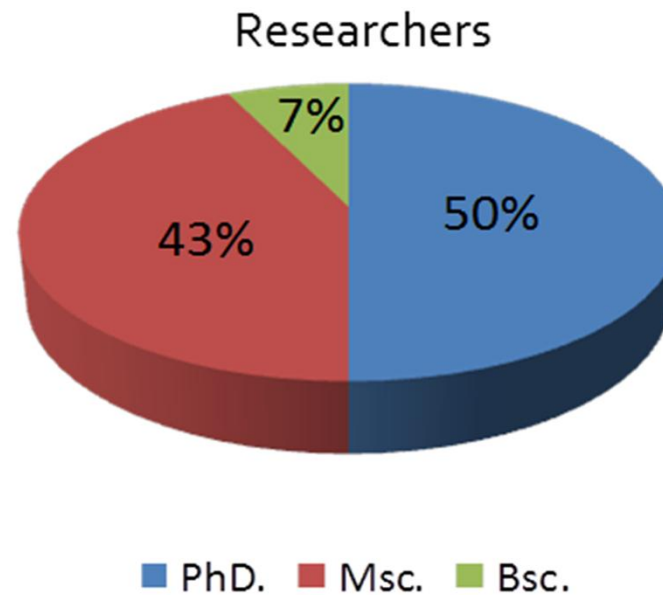


TÜBİTAK
MARMARA RESEARCH CENTER

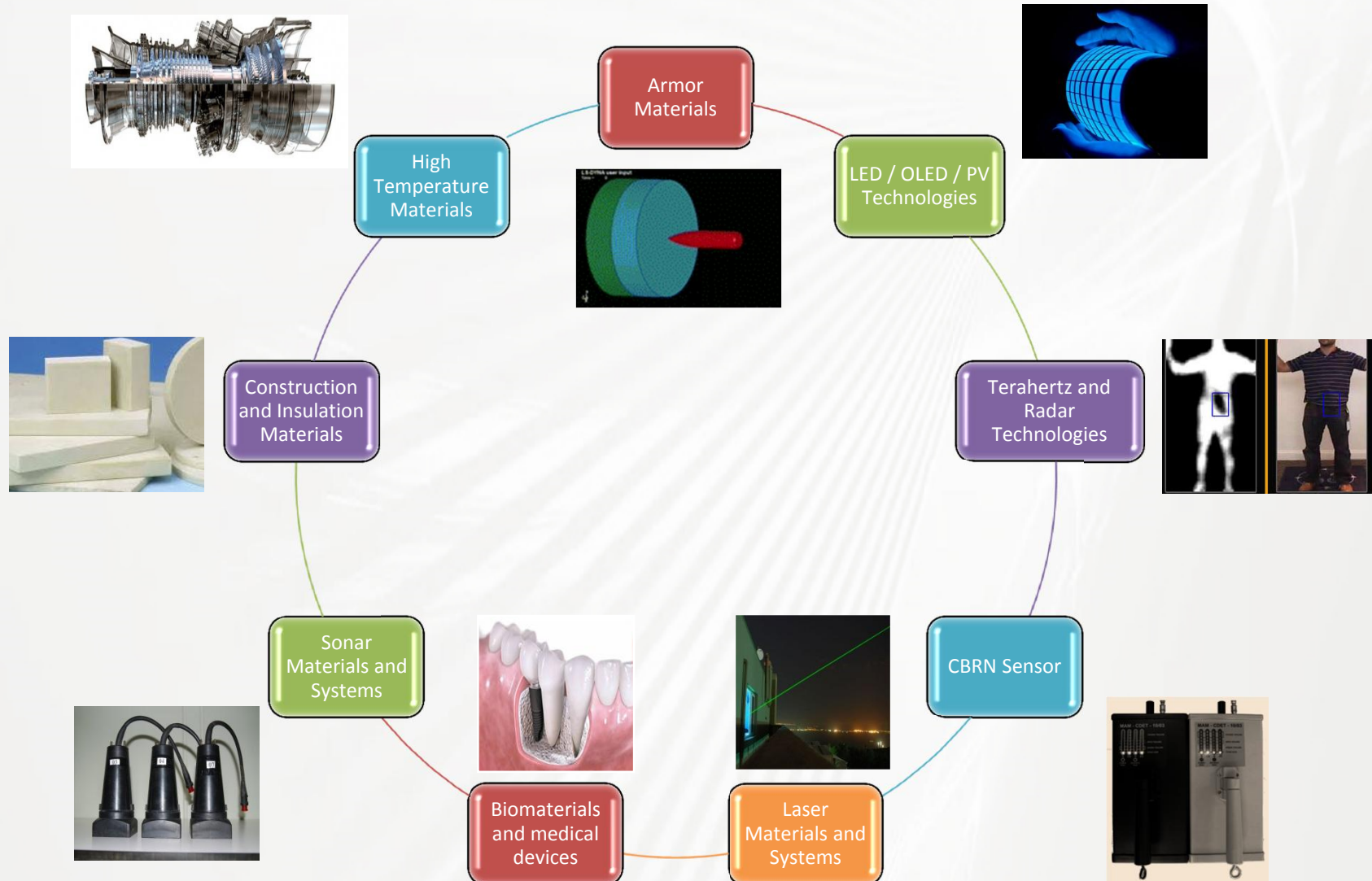
MATERIALS INSTITUTE

Employee Profile

Researchers	86	74%
Ph.D.	43	
Master's Degree	37	
Undergraduate	6	
Research Technician	29	24 %
Support Staff	3	2 %
TOTAL	121	

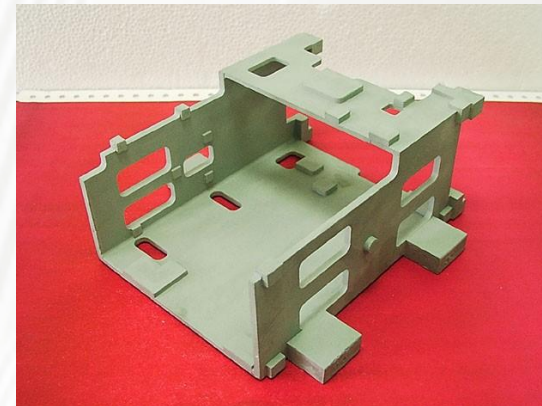
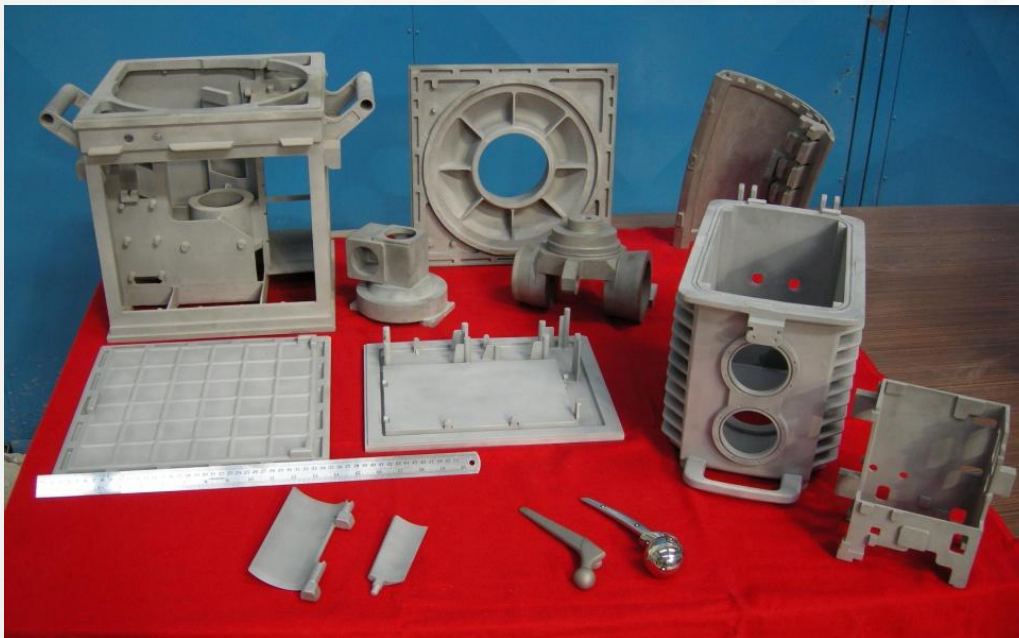


Priority Research Areas



Critical Metallic Materials Group

- High Temperature Materials
- Advanced Steels and Armour Steel Applications
- Aluminium, Titanium and Magnesium Alloy and Process Technologies
- Steam and Gas Turbine Materials
- Hydroelectric Power Plant Materials
- Superalloy and Investment Casting Technologies
- Metallography and Failure Analysis



CAST SUPERALLOY



Nickel based
superalloys:
Inconel 738LC
Inconel 617
Nimonic 75

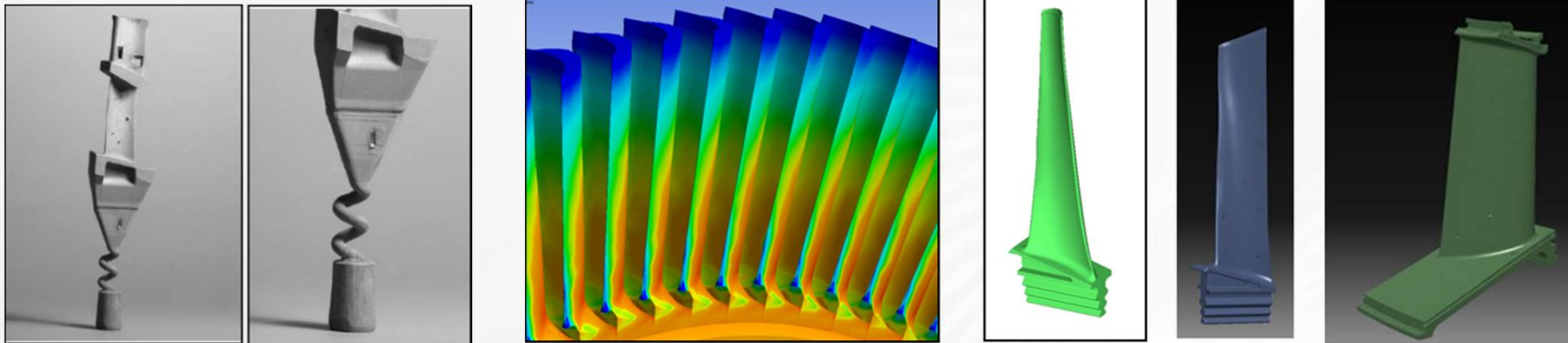


Cobalt based
superalloys:
Stellite 6B



Critical Metallic Materials - Projects

Nickel Based Single Crystal Superalloy Turbine Blade Project



Gas Turbine Blade Development Project

Obruk-Keban Dams Francis Turbine Rehabilitation



Rehabilitation and analysis of the corrosion and cavitation problems present at Obruk and Keban Hydroelectric Power Plants

Products

Steam and Gas Turbine Blades

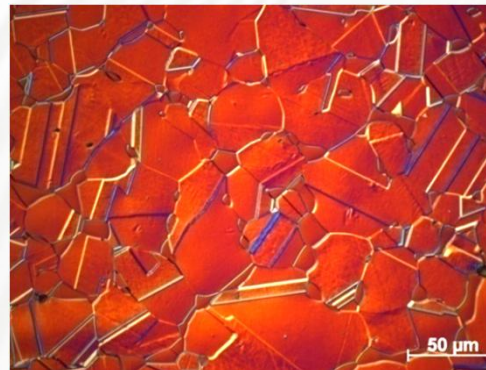
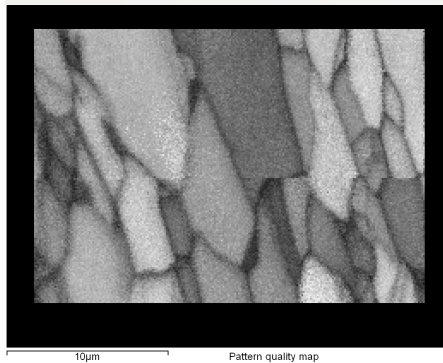


Titanium Casting



Ultra High Strength Steel

TWIP Steels
Dual Phase Steels
Martensitic Steels



- Wear-resistant & high temperature composite materials
- Ballistic composite materials: modelling, designing, development and manufacturing
- High engineering ceramics
- Nano-structural materials process and technologies
- Metallic and ceramic based foam materials
- Advanced powder metallurgy technologies



Composite Test Laboratory



Laboratory Scale Autoclave



Fiber Reinforced Polymer Composites



Optical Microscopes

Composite Test Laboratory

Fibre Reinforced Polymer composites are produced and tested.

Autoclave has computer aided full automatic curing system.

To observe effects of extreme climatic conditions (hot-cold), UV light and rain to the composites, climatic and UV cabins are used.

Surface characteristics of composites are investigated by Micro scratch tester and optical microscopes.



UV Cabin



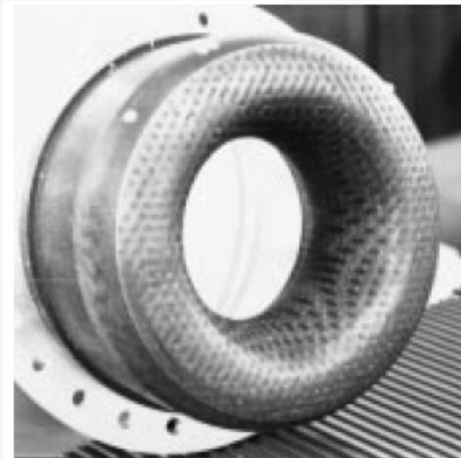
Climatic Cabin



Microscratch Tester

Products

Antifouling paint



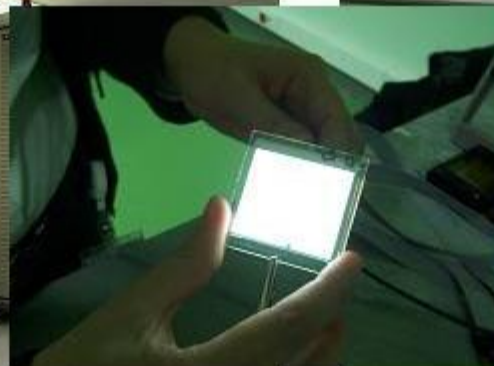
Carbon-SiC Materials

Train brake lining



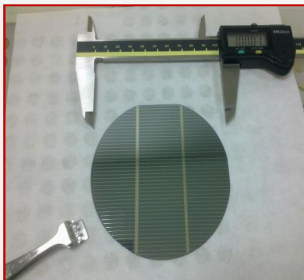
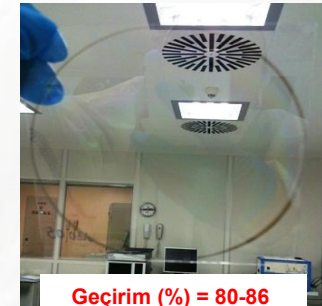
Photonic Technologies Group

- **Photovoltaic Technologies**
 - Silicon Photovoltaics
 - Organic Photovoltaics
- **LED / OLED Technology**
 - Display Systems
 - Lighting
- **Thin Film Electronics Technology**
 - Thin Film Transistors
 - Organic Electronics



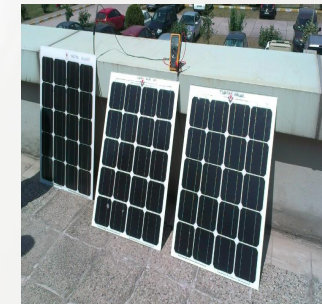
Products

Texturized transparent conductive oxide coated glass substrates for thin film photovoltaics



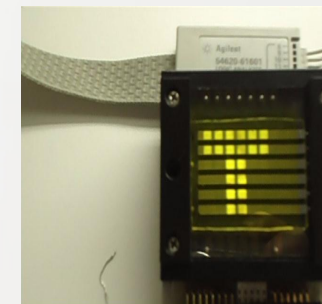
Mono crystalline silicon heterojunction solar cells

Crystalline silicon solar cell modules



OLED lighting panel

Passive Matrix OLED display



Biosensor, Acoustic, Laser, Nanomaterials and Coatings Group



➤ Biosensor, Biomaterials, Bioelectronic Materials

- Biosensor
- Biomaterial
- Bioelectronic
- Optic Sensor

➤ Sol-Gel Functional Coating Technologies

- Corrosion protective coatings
- High scratch/wear resistant coatings
- Antibacterial coatings
- Hydrophilic/hydrophobic coatings
- Fire resistant/flame retardant coatings
- Protection of cultural heritage
- Photocatalytic and anti-reflective coatings
- Wrinkle-free, and UV protective coatings in textiles

➤ Laser Technologies

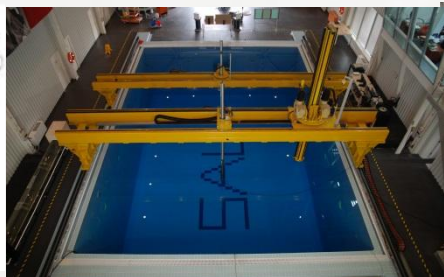
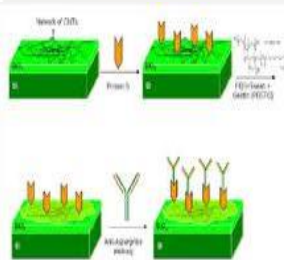
- Confocal Raman and Photoilluminance Microscope
- Laser Crystal Growth Studies
- Lidar Technology Studies
- Laser Based Spectroscopy Studies

➤ Acoustic Technologies

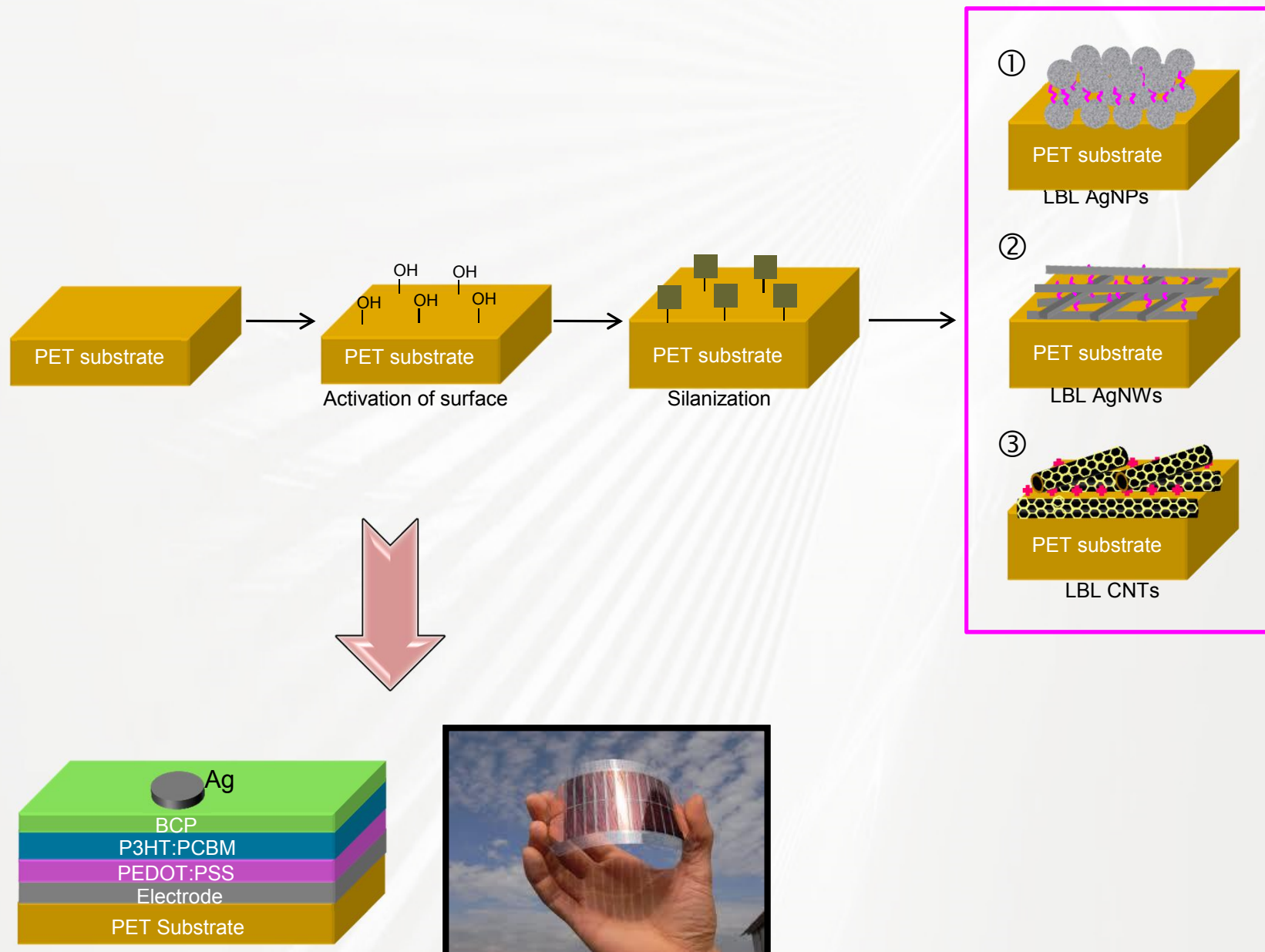
- Sonar Systems
- Transducer Technologies
- Vector Sensor Technologies
- Reference Hydrophone Calibration
- Acoustic Measurements
- Hydrostatic Pressure Test
- Temperature Controlled Impedance Test

➤ Nanotechnologic and Functional Materials

- Functional materials for sustainable energy efficiency
- Nanotechnological Processes , and nanostructured functional materials
- Photocatalytic material technologies
- Silicate technologies, and oxide based materials
- Functional glass and glass ceramics
- Cultural heritage glasses and ancient ceramics
- Functional product development for Industrial Symbiosis

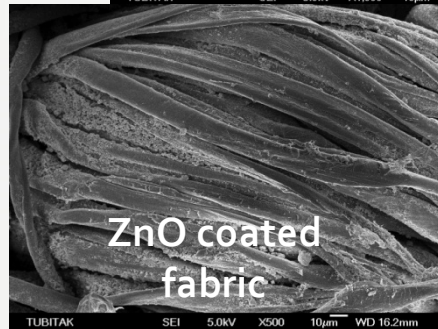


FP7 Preparation of ITO Free Transparent Conductive Electrode via LBL Deposition of CNTs and Its Application for Solar Cells

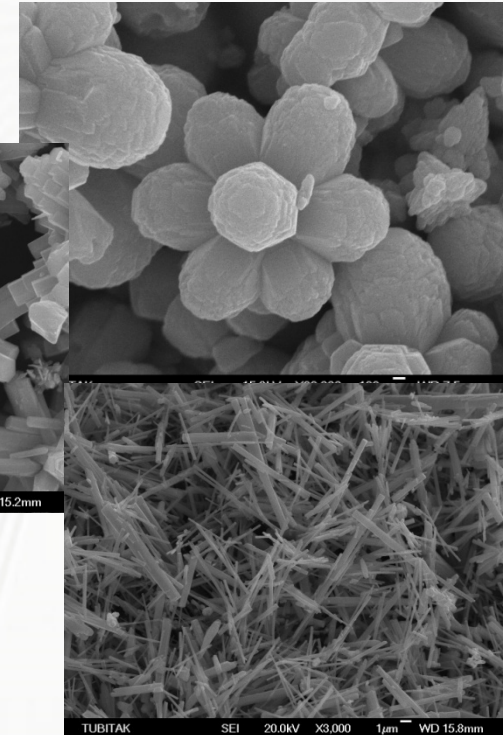
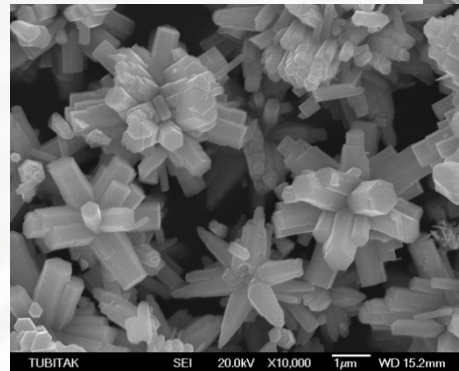


Functional Sol Gel Coatings

UV Protective Coatings on Textiles



nano Zinc oxide powders for UV protection

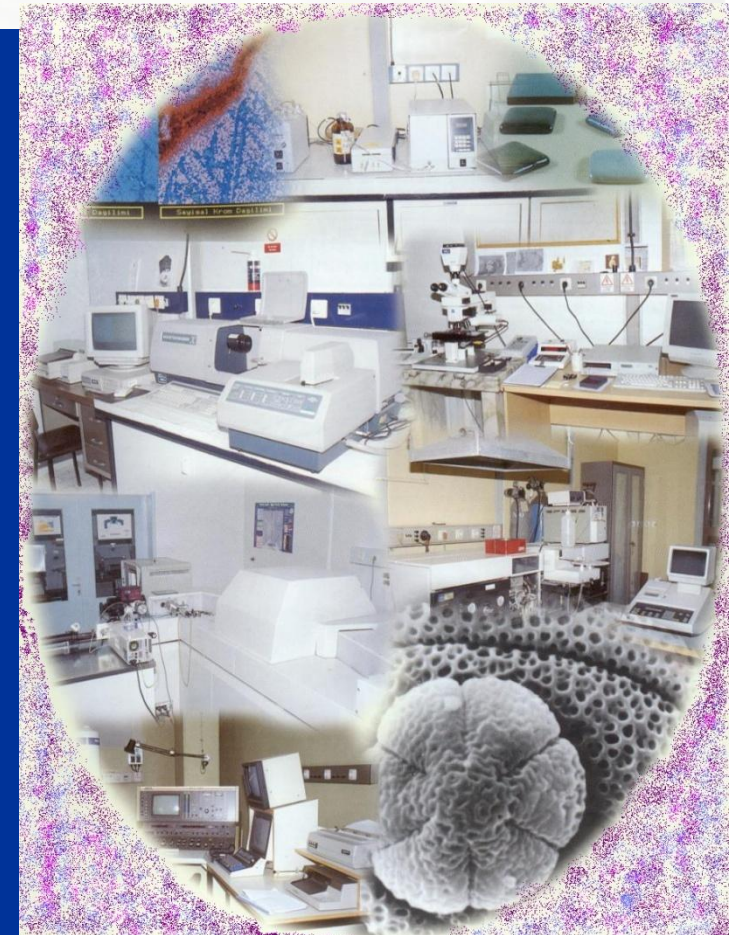


Spray test on hydrophobic fabric



TESTING, ANALYSIS & CHARACTERISATION LABORATORIES - EN ISO / IEC17025

- TESTING ANALYSIS & CHARACTERISATION SERVICES FOR INDUSTRY ELUCIDATION OF MATERIALS STRUCTURE
 - QUALITATIVE PHASE ANALYSIS
 - QUANTITATIVE ELEMENTAL ANALYSIS IN ORGANIC & INORGANIC MATERIALS
 - FAILURE ANALYSIS; MACROSCOPIC INVESTIGATIONS
 - CORROSION TESTS
 - PARTICLE SIZE DISTRIBUTION ANALYSIS
 - MECHANICAL TESTS
 - MICROCHEMICAL & MICROSTRUCTURAL CHARACTERISATIONS, COATING MORPHOLOGY, INTERFACE INTERPRETATIONS, SPECIFIED IMAGE PROCESSING ANALYSIS (SEM-TEM)



PANALYTICAL X'PERT PRO MPD X-RAY DIFFRACTOMETER

Qualitative Phase Analysis

Quantitative Phase Analysis

High Temperature Phase Analysis
(1800 °C)

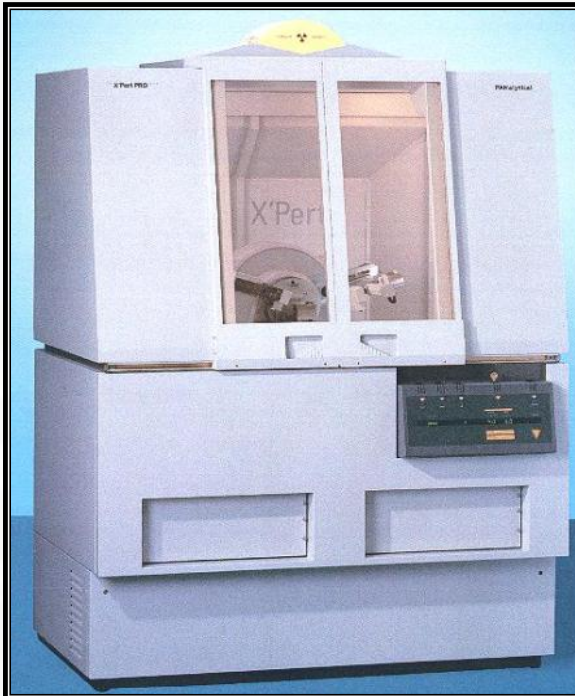
Point Focus Phase Analysis
(min. 500 µm)

Thin Film Analysis

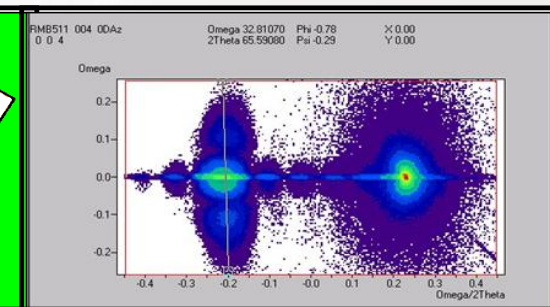
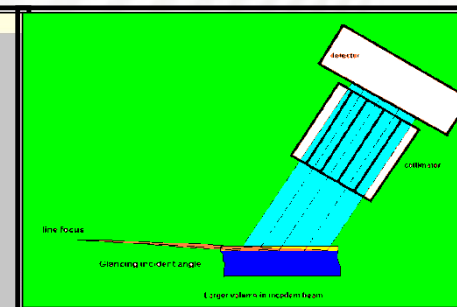
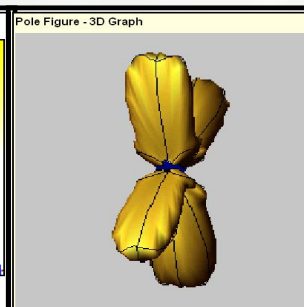
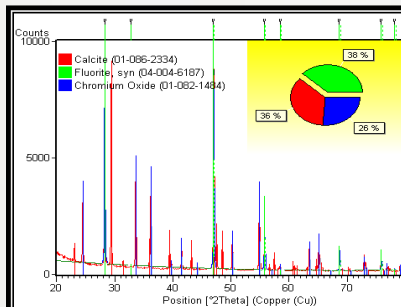
Reflectivity and Epitaxy Analysis

Residual Stress Analysis

Texture Analysis

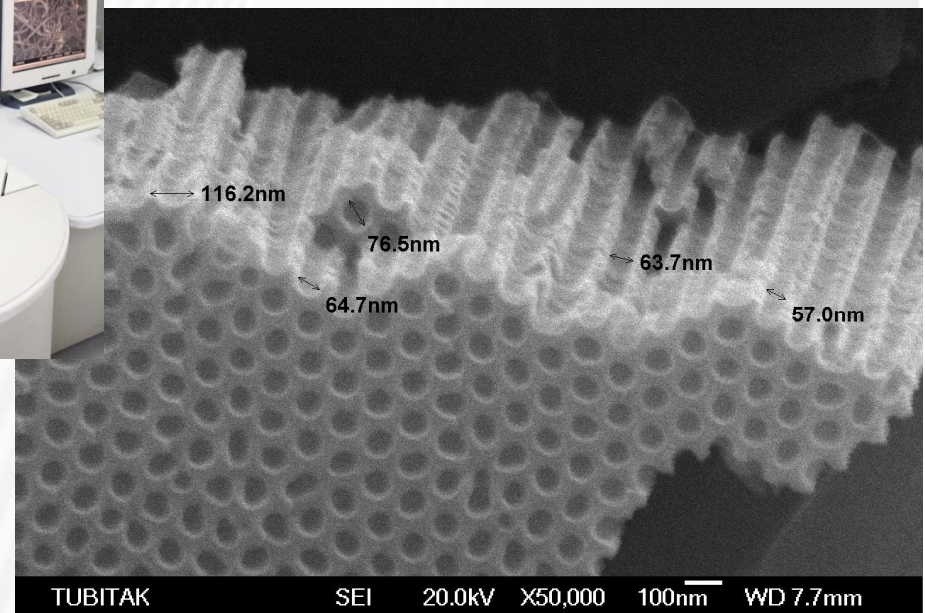
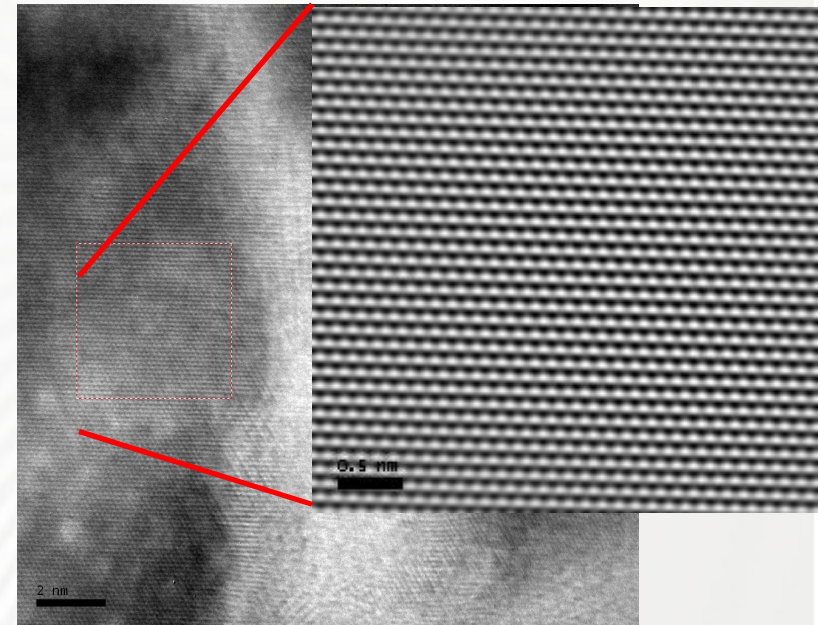
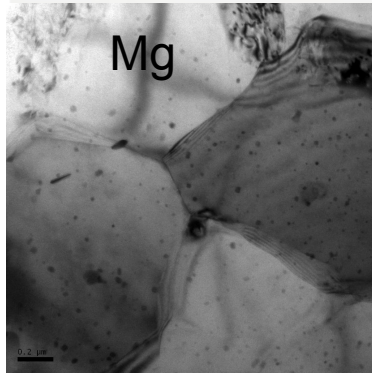


- Qualitative phase analysis with using PDF-4
- Quantitative phase analysis, indexing, size-strain determination, amorph phase content by using Rietveld method,
- Determination of phase change during sintering by using the high temperature (max. 1800 °C)
- Point focus phase analysis until 0,5 mm2
- Residual Stress analysis by using stress software
- Texture analysis by using texture software
- Reflectivity, Thin film and Epitaxy analysis



Electron Microscopy Laboratories

- JEOL 2100 LaB6 HRTEM, Oxford EDS
- JEOL 100C TEM
- Sample Preparation for HRTEM: PIPS, dimple grinding, electropolishing
- FEG-SEM: JEOL-6335F, Oxford EDS-EBSD
- JEOL JSM 6510-LV SEM, Oxford EDS



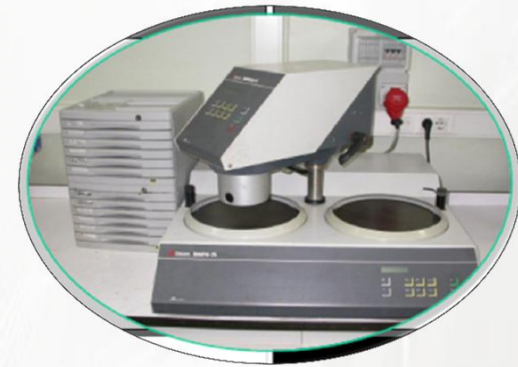
Metallography and Failure Analysis Laboratory



UNITOM – 50
Cutting machine



STRUERS PRONTOPRESS-20
Hot mounting



STRUERS ROTOPOL
25//ROTOFORCE-4
Sample polishing



NIKON L150
Optic microscope



STEMI SV 6
Stereo microscope



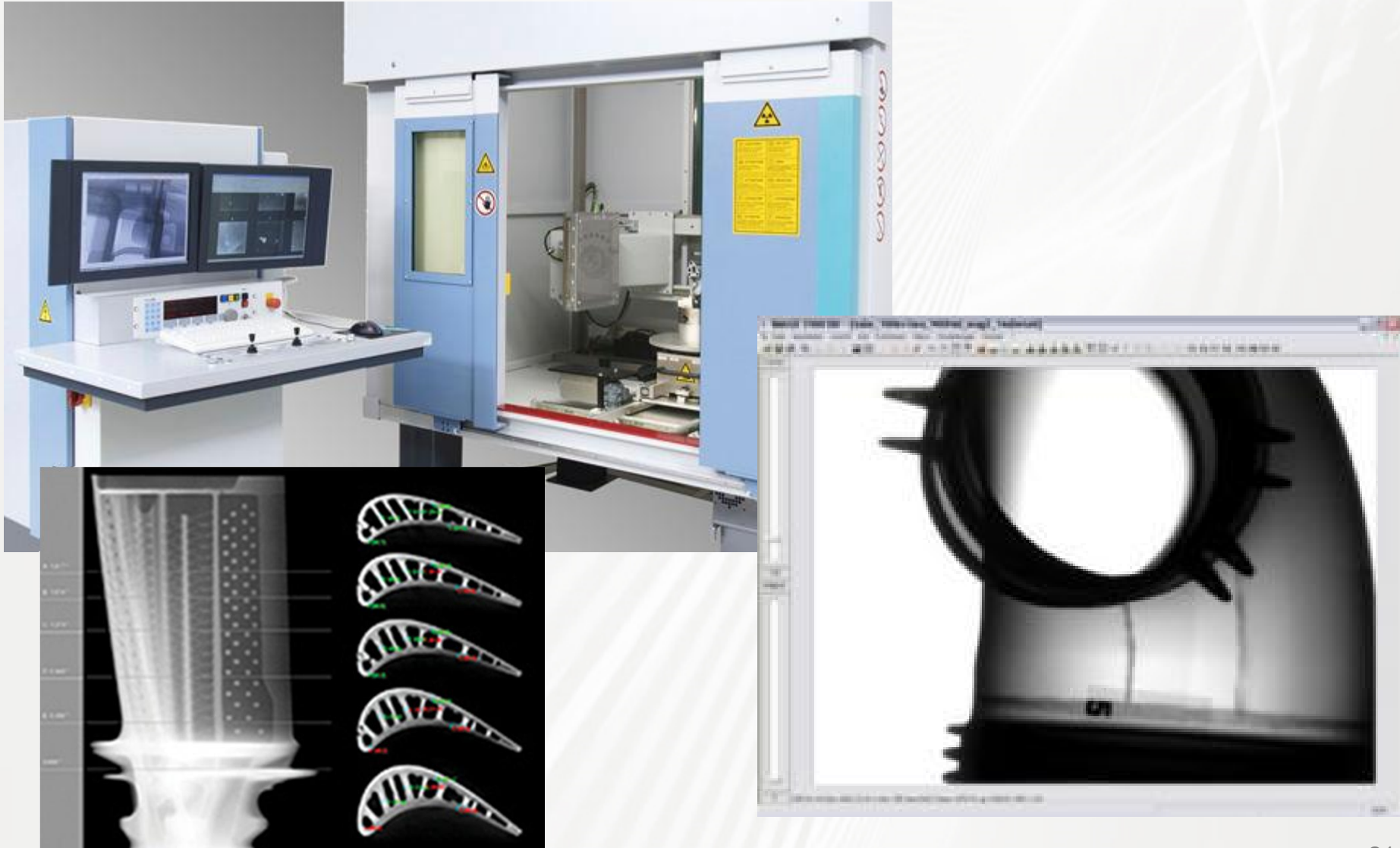
Drying oven

High Temperature Testing Laboratory

- Universal Mechanical Testing 600kN, 1200°C
- Fatigue Test Device, 100kN, 1100°C
- Creep Test Machines, 1200°C
- DSC-DTA-TGA-1600°C



320 kV X-ray and CT (Computed Tomography) system



Investigation on the Potential of Mg as an Implant

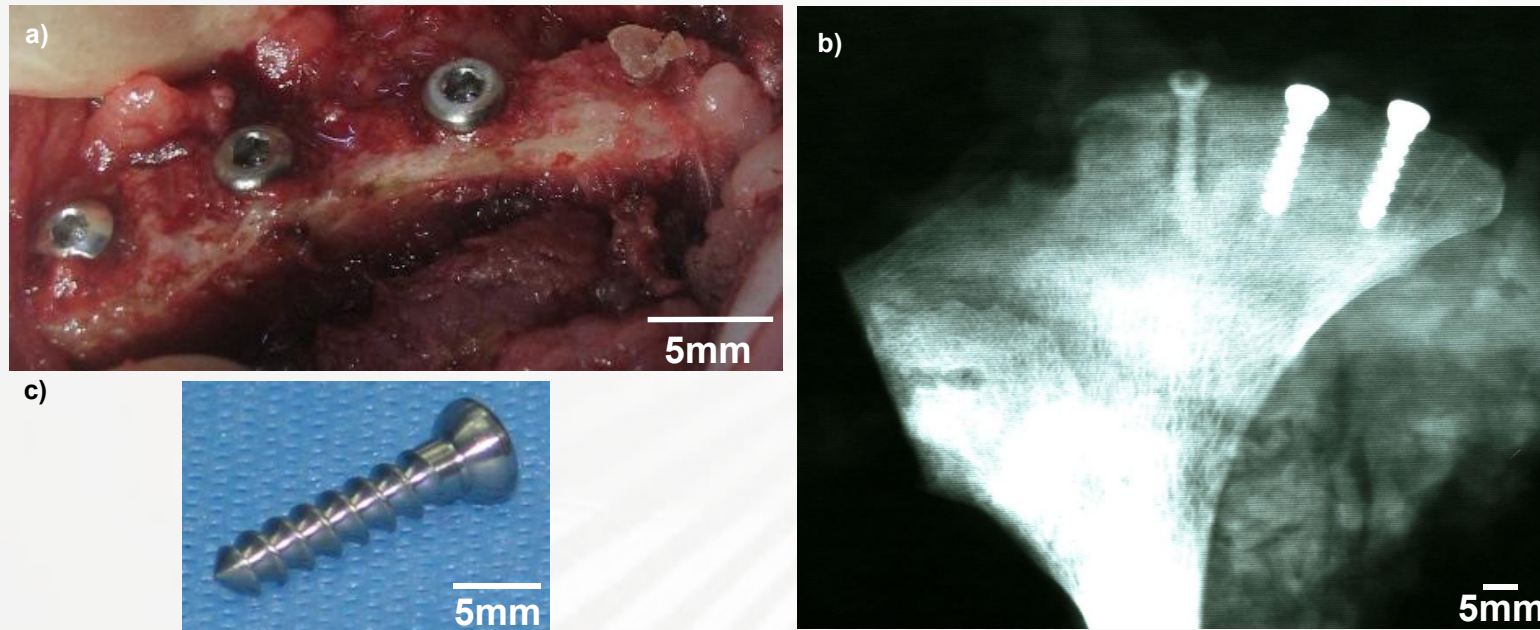
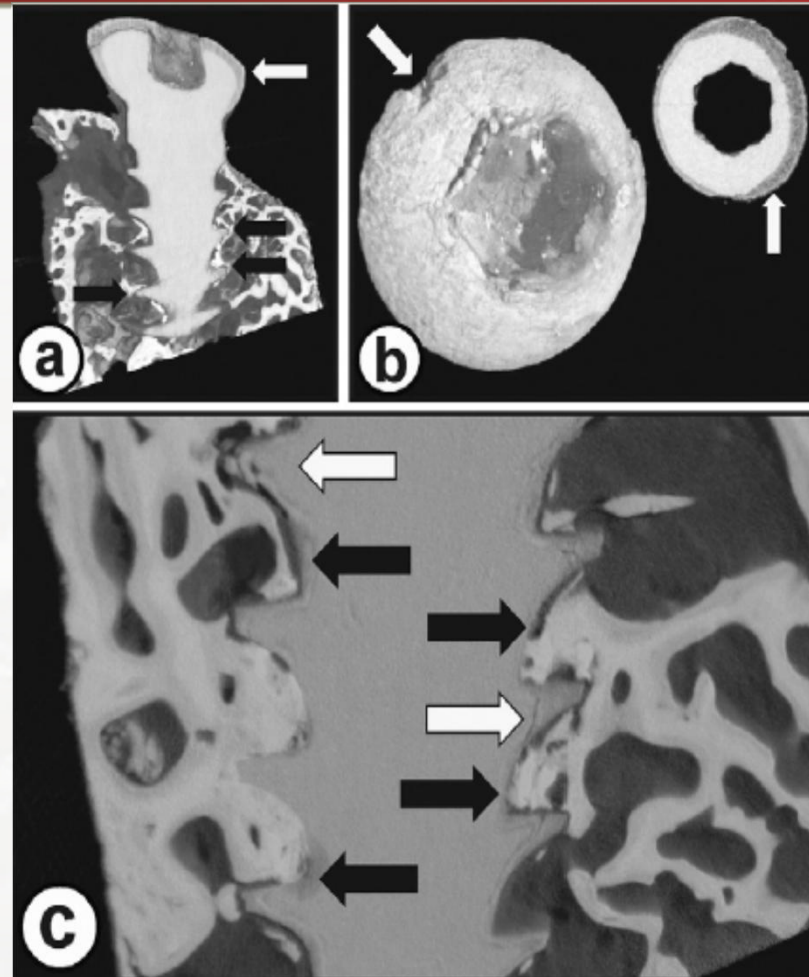


Figure. a) Screw implantation via surgery in sheep hip bone, b) radiographic view of implanted screws, (from left to right: magnesium, titanium, hydroxyapatite coated titanium and bioabsorbable polymer) and c) picture of the screw used in the experiments.

R.A. Kaya, H. Cavusoglu, C. Tanik, A.A. Kaya, O. Duygulu, Z. Mutlu, E. Zengin, Y. Aydin, J. Neurosurg. Spine 6 (2007) 141–149.

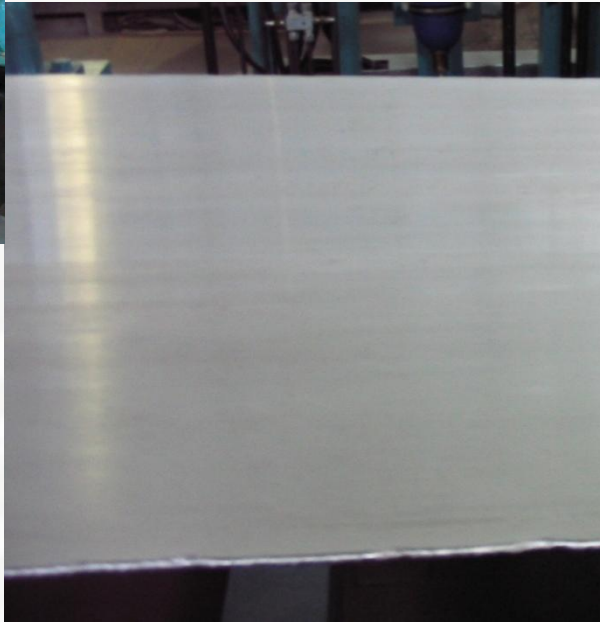
Useful Corrosion?- Potential of Magnesium Alloys as Implants, A. Arslan Kaya, R. Alper Kaya, Frank Witte and Ozgur Duygulu, Corrosion Science and Technology, (2008) Vol 7, No:3, pp.162-167

Synchrotron-micro-computed tomography



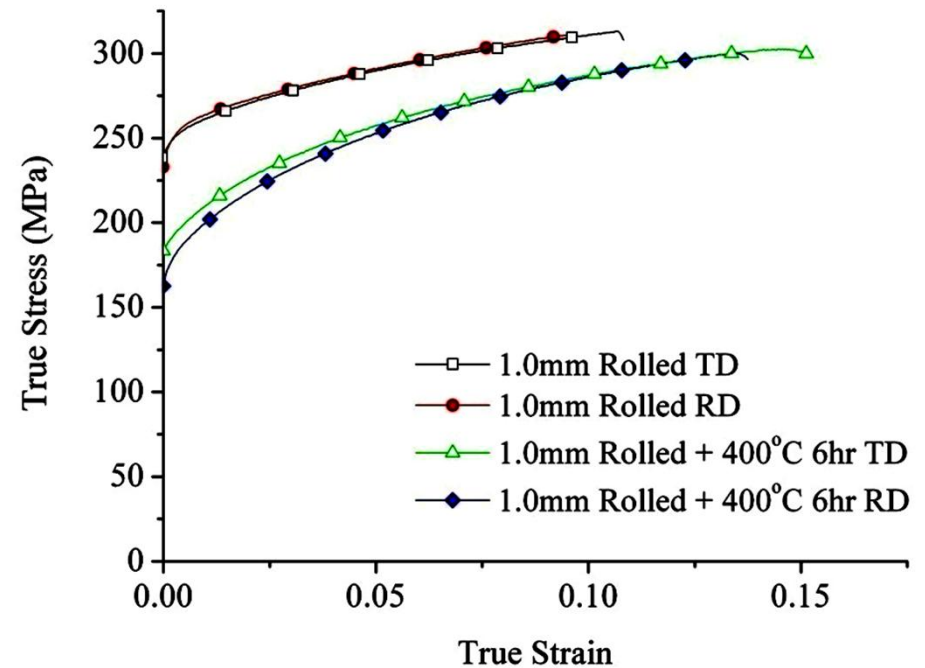
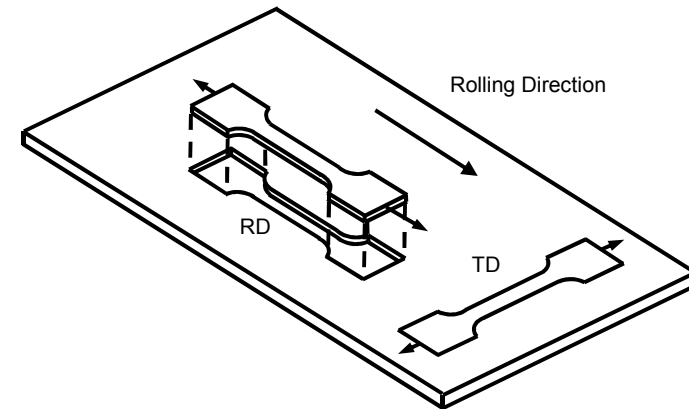
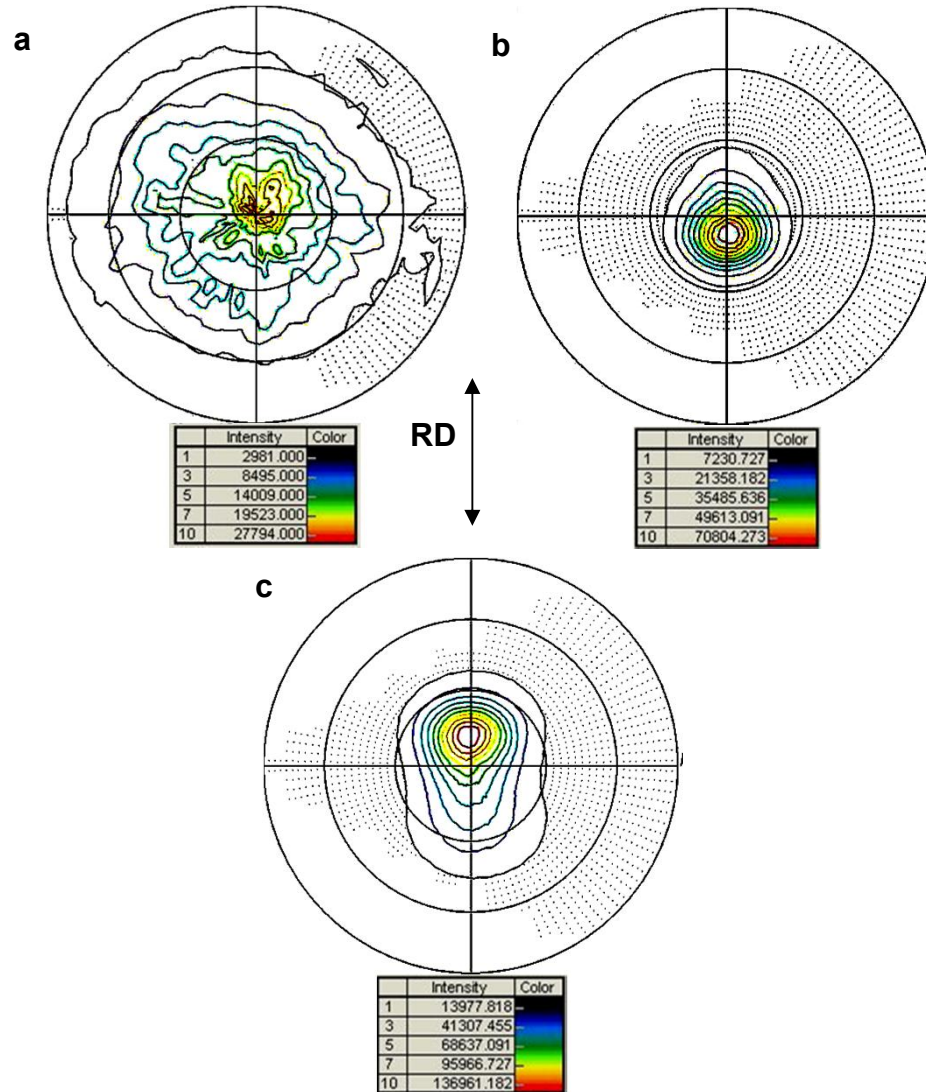
Synchrotron-radiation based micro-computed tomography views of an explanted magnesium screw after **6 months** (thread diameter of screw 3.5 mm). Note the prominent corrosion layer in the head (white arrows in a and b) and on the thread tips (white arrows in (c)), and the massive ingrowth of woven bone into the pitches of the thread (black arrows in a and c).

Mg Twin Roll Casting-Warm Rolling



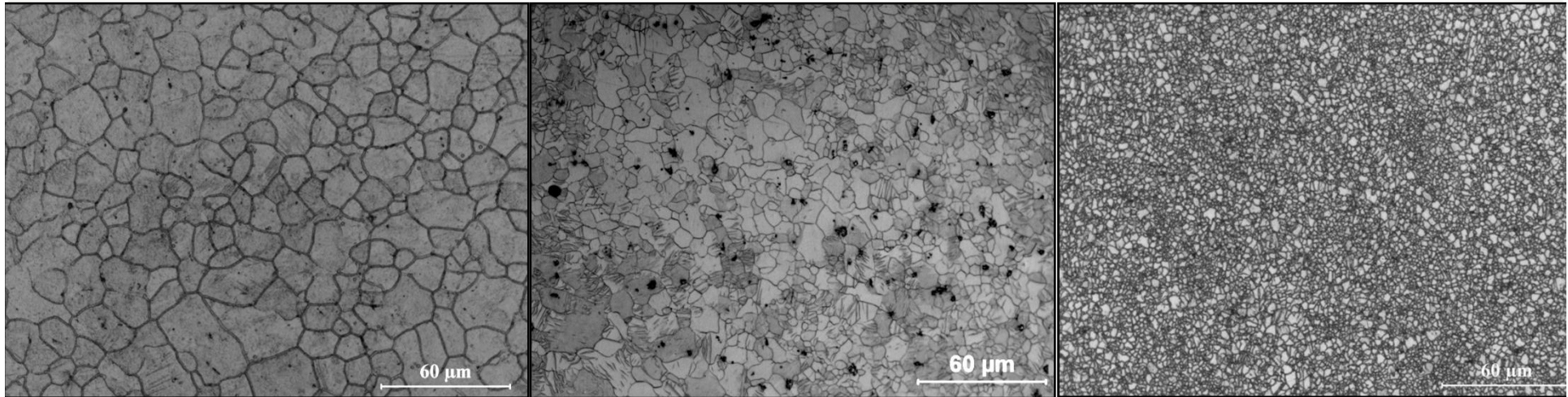
- 1500 mm wide magnesium alloy AZ31, AZ61, AZ91, AM50 and AM60 sheets of 4-8 mm thickness were produced by twin-roll strip casting first time by TUBITAK MRC Materials Institute in Turkey.
- These are the first industrial scale and widest magnesium alloy sheets that have been produced by this method in the world by year 2007.

XRD Texture Studies



(0002) pole figures of **a)** as-cast 6.5 mm, **b)** rolled 1.0 mm AZ31 alloy and **c)** commercially available 1.0 mm AZ31 alloy sheets.

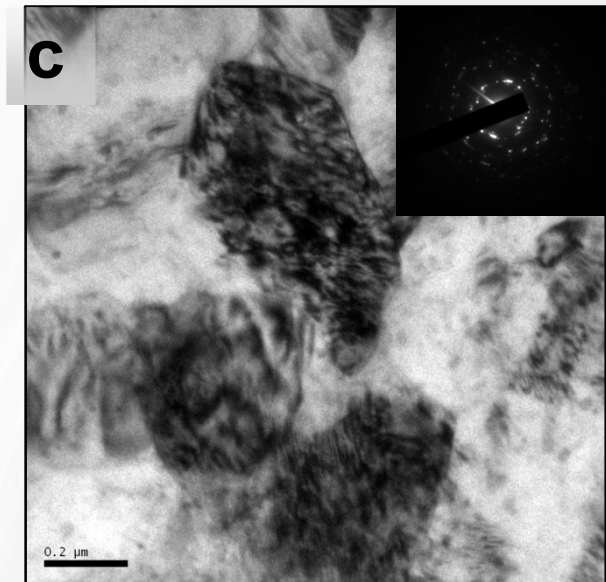
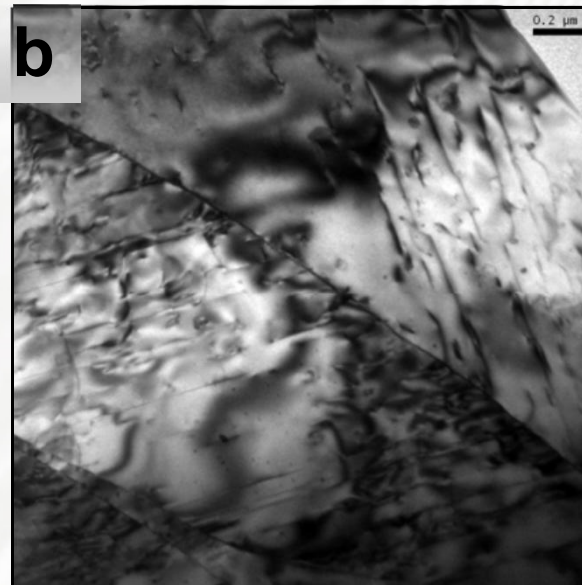
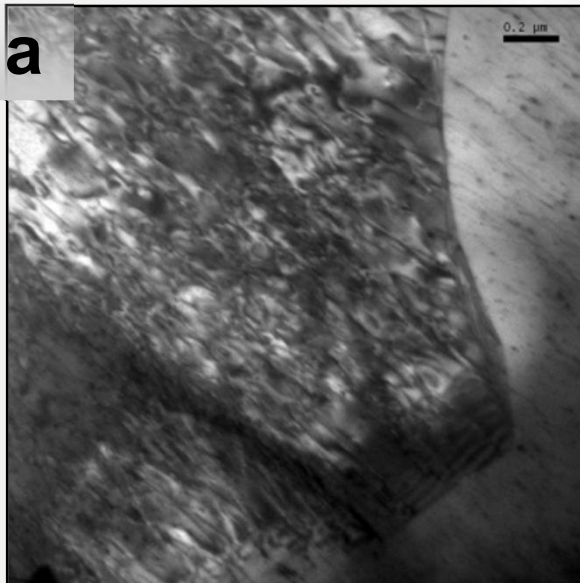
Asymmetric Rolling (ASR)



As Homogenized

After Warm Rolling

After ASR



Asymmetric Rolling (ASR)

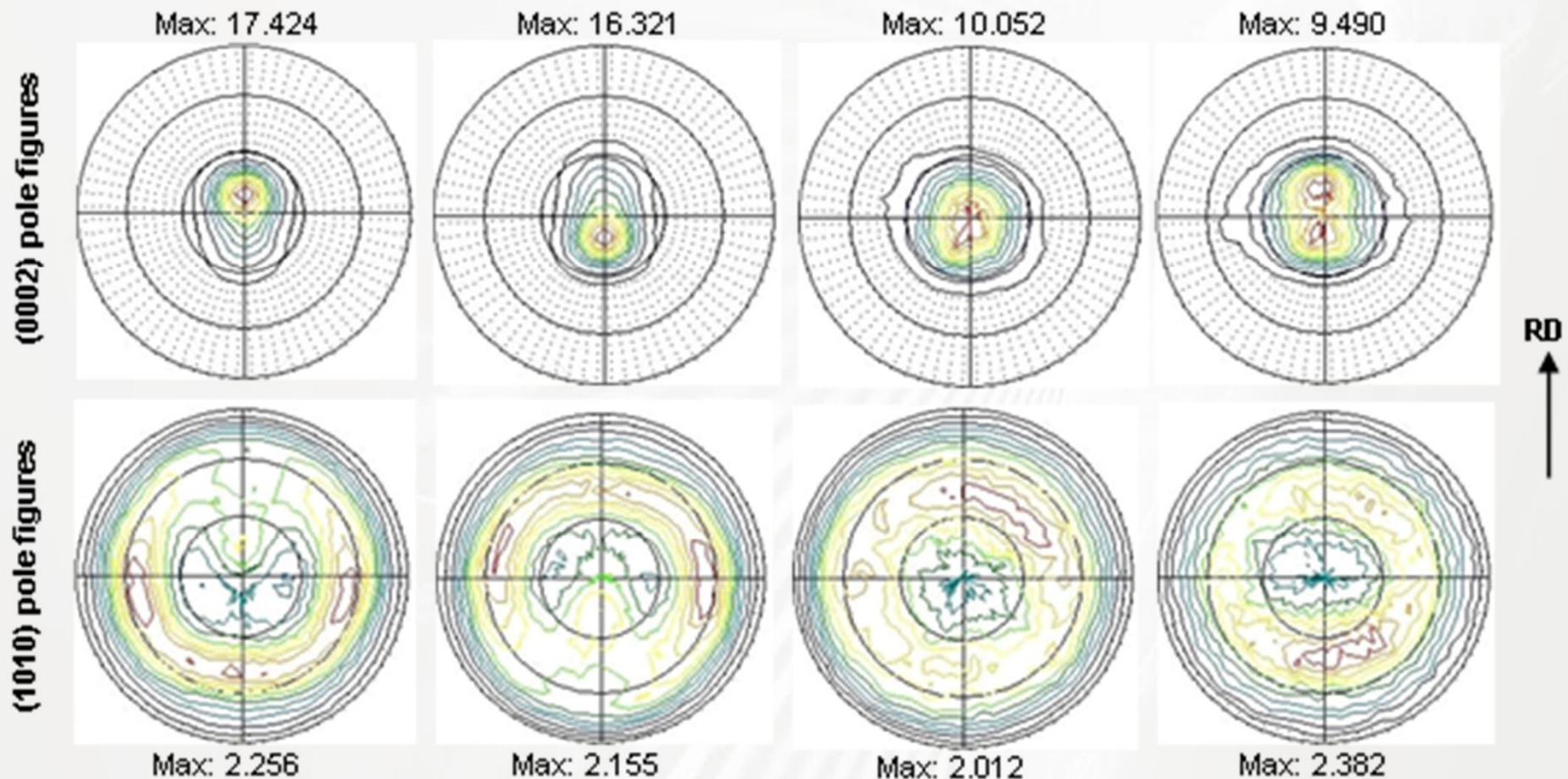
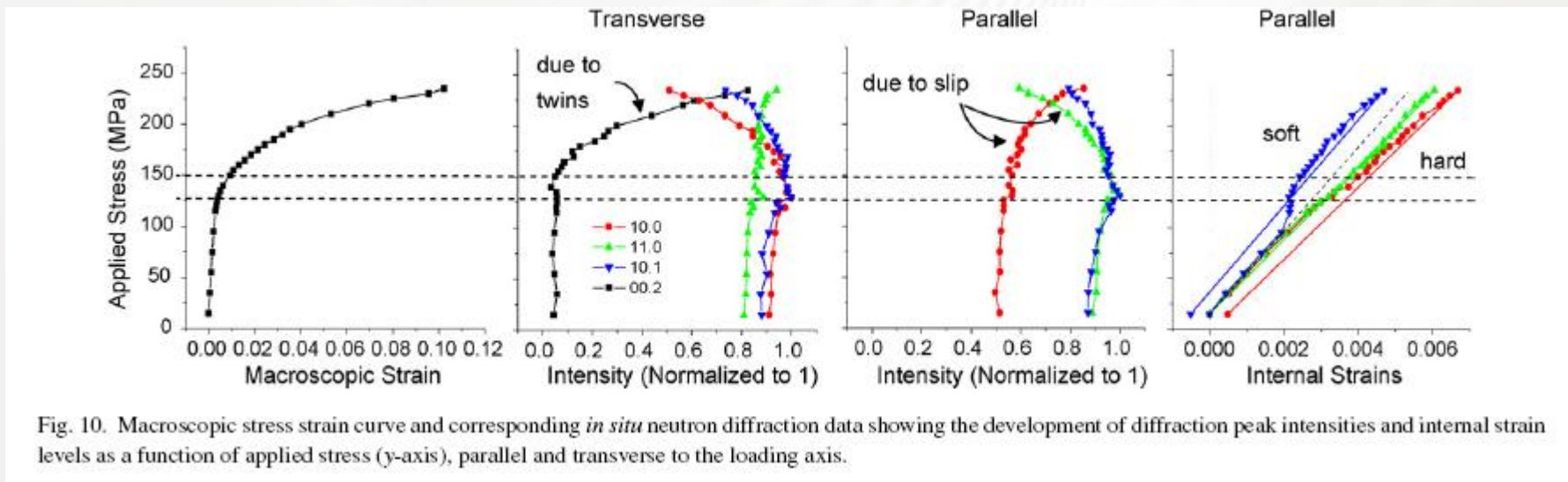


Figure (0002) and (1010) pole figures of the **(a)** commercially available AZ31 1mm sheet, **(b)** commercially available AZ31 2mm sheet, **(c)** symmetrically rolled AZ31 2mm sheet and **(d)** asymmetrically rolled AZ31 2mm sheet.

Neutron Diffraction

- Plastic anisotropy and the role of non-basal slip in magnesium alloy AZ31B
- Grain size effects on the tensile properties and deformation mechanisms of a magnesium alloy, AZ31B, sheet

Spectrometer for Materials Research at Temperature and Stress (SMARTS) at the Manuel Lujan Jr. Neutron Scattering Center (LANSCE), Los Alamos National Laboratory



Thank you