

DELFT UNIVERSITY OF TECHNOLOGY

Department of Materials Science and Engineering

Mekelweg 2, 2628 CD Delft, the Netherlands

**Graduate School MSE Experimental Trainings** *(1.5 ECTS is equivalent to 5 GS credit points)*

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| **Training** | **Responsible** | **ECTS credits (preparation + contact hours)** | **GS credits (translation from ECTS)** |
| Dilatometry – Normal & Tensile | Nico Geerlofs | 0.6 | 2 |
| Sample preparation (grinding, thermocouple welding)Experimental setupDesign heat treatmentsHow to use the softwareProcessing of results |
| Vibrating Sample Magnetometer | Nico Geerlofs | 0.3 | 1 |
| Sample preparationCalibration of the equipmentPrinciples of magnetic properties of materialsMeasuring retained austenite content with VSMHigh temperature measurements |
| Gleeble | Hans Hofman | 0.3 | 1 |
| Simulation of thermomechanical processesForging and rollingSimulation of weldingSample preparationControl software operationProcessing of results |
| Welding Equipment Training | Jurriaan v. Slingerland | 0.15 | 0.5 |
| Laser safety and welding safetyDescription of the available welding techniques (Gas Metal Arc Welding, Gas Tungsten Arc Welding, Shielded Metal Arc Welding, laser welding)Setup of the Welding techniquesDescription of welding parameters for each technique |
| Mechanical Testing | Ton Riemslag | 0.3 | 1 |
| Tensile testingFatigue testingThermomechanical Fatigue testingHardness testingSpecimen design |
| Advanced X-Ray Diffraction &Advanced X-Ray Fluorescence  | Ruud Hendrikx | 0.45 | 1.5 |
| Theoretical background on diffractionRadiation safetyExperimental set-upPost-processing data (diffraction pattern) |
| Spark Plasma Sintering | Hans Brouwer | 0.3 | 1 |
| Sample preparationExperimental set-up |
| Differential Thermal Analysis (DTA) – Thermal Gravimetric Analysis (TGA) | Hans Brouwer | 0.45 | 1.5 |
| Sample preparationExperimental set-upPost-processing data |
| X-Ray Photon Spectroscopy | Hans Brouwer | 0.15 | 0.5 |
| Theoretical background on XPSSample preparationExperimental setupPost-processing |
| Extended Sample preparation (for non-conductive/oxidized samples) | Kees Kwakernaak | 0.3 | 1 |
| Cr/Cu/Pt coatingCross-section ion polishingCarbon coating |
| Scanning Electron Microscopy & Electron Back Scatter Diffraction | Kees Kwakernaak | 0.6 | 2 |
| Principles of SEM and EBSDSample preparationExperimental Setup (SEM/EBSD)Working with the microscopeDetectorsEDSSetting up a measurement in SEM/EBSDPost-processing of data |
| Electron Back Scatter Diffraction\* | Roumen Petrov | 0.6 | 2 |
| Principles of EBSDSample preparationExperimental Setup EBSDWorking with the microscopeSetting up an EBSD measurementPost-processing of dataPrinciples of TKD technique |
| Transmission Electron Microscopy\* | Vitaliy Bliznuk(Roumen Petrov) | 1.5 | 5 |
| Principles of TEMSample preparationElectropolishing and PIPS (Precise Ion Polishing System)TEM instrumentation (magnetic lens, mechanical apertures, the vacuum/illumination systems, cameras for images taking)Image and diffraction pattern formation (bright/dark fields-TEM, select area diffraction, convergent electron beam diffraction, high resolution TEM, bright and dark field scanning TEM, High angular annular dark field STEMFactors affecting the imageCommonly observed artefactsBright and dark field scanning TEM Energy Dispersive Spectroscopy measurementsPost-processing of data with GATAN Digital Micrograph softwareIndexing of diffraction pattern |
| Focus Ion Beam Milling\*\* | Hozan Miro | 0.6 | 2 |
| Introduction of the FIB-SEM system/configuration.Mechanism of the processing and image forming. Introduction of sampling limit and sample mounting to the stage.Setting of eucentric height and starting the ion source and form images.Alignment when changing the aperture under ion beam mode.Familiar with patterning and extract designed pattern step by step.Learn to start, modify and finish the steps for automatic milling procedure to extract TEM lamellae. How to finish the session in safe steps. |
| Scanning Vibrating Electrode | Agnieszka Kooijman | 0.15 | 0.5 |
| Theoretical backgroundSample preparationUse of SoftwarePreparing and controlling tipsCalibrationSample analysis |
| Microcell | Agnieszka Kooijman | 0.3 | 1 |
| Theoretical backgroundSample preparationPutting and coating micro-capillariesUse of softwareUse of PotentiostatSetting up the electrochemical cellAnalysis of results |
| Atomic Force Microscopy / Scanning Kelvin Probe | Agnieszka Kooijman | 0.15 | 0.5 |
| Theoretical backgroundSample preparationUse of software and equipmentData analysis |
| Microstructural Analysis:* Sample preparation
* LOM
* Keyence 3D Microscope
* Microhardness
 | Sander van Asperen | 0.30 | 1 |
| Sample preparation (Cutting, grinding, polishing, and etching)Light Optical microscopyKeyence 3D Microscope (2D mode, 3D mode, stitching, profiling, particle analysis, measuring areas)Microhardness (principles of Vickers measurements, single measurement, series of measurements). |

\*Ghent University of Technology

\*\*Applied Physics, TUDelft