

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 setup  Design heat treatments  How to use the software  Processing of results | | | |
| Vibrating Sample Magnetometer | Nico Geerlofs | 0.3 | 1 |
| Sample preparation  Calibration of the equipment  Principles of magnetic properties of materials  Measuring retained austenite content with VSM  High temperature measurements | | | |
| Gleeble | Hans Hofman | 0.3 | 1 |
| Simulation of thermomechanical processes  Forging and rolling  Simulation of welding  Sample preparation  Control software operation  Processing of results | | | |
| Welding Equipment Training | Jurriaan v. Slingerland | 0.15 | 0.5 |
| Laser safety and welding safety  Description of the available welding techniques (Gas Metal Arc Welding, Gas Tungsten Arc Welding, Shielded Metal Arc Welding, laser welding)  Setup of the Welding techniques  Description of welding parameters for each technique | | | |
| Mechanical Testing | Ton Riemslag | 0.3 | 1 |
| Tensile testing  Fatigue testing  Thermomechanical Fatigue testing  Hardness testing  Specimen design | | | |
| Advanced X-Ray Diffraction &  Advanced X-Ray Fluorescence | Ruud Hendrikx | 0.45 | 1.5 |
| Theoretical background on diffraction  Radiation safety  Experimental set-up  Post-processing data (diffraction pattern) | | | |
| Spark Plasma Sintering | Hans Brouwer | 0.3 | 1 |
| Sample preparation  Experimental set-up | | | |
| Differential Thermal Analysis (DTA) – Thermal Gravimetric Analysis (TGA) | Hans Brouwer | 0.45 | 1.5 |
| Sample preparation  Experimental set-up  Post-processing data | | | |
| X-Ray Photon Spectroscopy | Hans Brouwer | 0.15 | 0.5 |
| Theoretical background on XPS  Sample preparation  Experimental setup  Post-processing | | | |
| Extended Sample preparation (for non-conductive/oxidized samples) | Kees Kwakernaak | 0.3 | 1 |
| Cr/Cu/Pt coating  Cross-section ion polishing  Carbon coating | | | |
| Scanning Electron Microscopy & Electron Back Scatter Diffraction | Kees Kwakernaak | 0.6 | 2 |
| Principles of SEM and EBSD  Sample preparation  Experimental Setup (SEM/EBSD)  Working with the microscope  Detectors  EDS  Setting up a measurement in SEM/EBSD  Post-processing of data | | | |
| Electron Back Scatter Diffraction\* | Roumen Petrov | 0.6 | 2 |
| Principles of EBSD  Sample preparation  Experimental Setup EBSD  Working with the microscope  Setting up an EBSD measurement  Post-processing of data  Principles of TKD technique | | | |
| Transmission Electron Microscopy\* | Vitaliy Bliznuk  (Roumen Petrov) | 1.5 | 5 |
| Principles of TEM  Sample preparation  Electropolishing 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 STEM  Factors affecting the image  Commonly observed artefacts  Bright and dark field scanning TEM Energy Dispersive Spectroscopy measurements  Post-processing of data with GATAN Digital Micrograph software  Indexing 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 background  Sample preparation  Use of Software  Preparing and controlling tips  Calibration  Sample analysis | | | |
| Microcell | Agnieszka Kooijman | 0.3 | 1 |
| Theoretical background  Sample preparation  Putting and coating micro-capillaries  Use of software  Use of Potentiostat  Setting up the electrochemical cell  Analysis of results | | | |
| Atomic Force Microscopy / Scanning Kelvin Probe | Agnieszka Kooijman | 0.15 | 0.5 |
| Theoretical background  Sample preparation  Use of software and equipment  Data 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 microscopy  Keyence 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