

Workshop on Advanced TEM Sample Preparation

Stuttgart, 24th – 28th October 2022

Introduction and concept:

ESTEEM3 – Enabling Science and Technology through European Electron Microscopy – is an EU funded project for electron microscopy, which aims at providing access to the leading European state-of-the-art electron microscopy research infrastructures, facilitating and extending transnational access services of the most powerful atomic scale characterization techniques in advanced electron microscopy research to a wide range of academic and industrial research communities for the analysis and engineering of novel materials in physical, chemical and biological sciences.

Specimen preparation is the initial key step in various transmission electron microscopy (TEM) investigations, especially for the applications of sophisticated instruments with monochromators, aberration correctors, high-end detectors and energy filters. The quality of the TEM specimen plays a direct role in the quality of the results obtained on the microscope. Therefore, knowing how to prepare high-quality TEM specimens and advancing related skills are crucial.

The goal of the workshop was to provide a platform for sharing experiences and know-how of a spectrum of TEM specimen preparation techniques. The workshop participants were scientific and technical staff from TEM laboratories aiming to broaden their knowledge and hands-on skills in TEM specimen preparation for different materials systems from physical and biological sciences. The workshop extensively covered different preparation techniques including ion milling, (cryo-) ultramicrotomy, automated tripod polishing, and focused ion beam (FIB).

Location and infrastructure:

The Workshop on Advanced TEM Specimen Preparation was held at the Stuttgart Center for Electron Microscopy (StEM) of the Max Planck Institute for Solid State Research, Stuttgart, Germany. The StEM is well equipped with state-of-the-art instrumentation for applying a wide range of TEM specimen preparation techniques. In order to employ the above-mentioned techniques, various diamond saws, grinding and dimpling equipment, ion-milling systems PIPS I and PIPS II (Gatan), NanoMill® (Fischione) and others, FIB/SEM (Thermo Fisher), tripod-polishing systems Techprep™ (Allied), (cryo-) microtome EM UC6/UC7 (Leica) and trimming instrument EM TRIM2 (Leica) for ultramicrotomy, and the necessary auxiliary devices have been used. The hands-on trainings and demonstrations took place in the specimen preparation labs of StEM.

Scientific content and program:

The program consisted of

- One introduction lecture
- Five lab courses focusing on hands-on trainings and experiments held by StEM staff members
- Five presentations of companies, who gave introductions to their recent developments in instrumentation for TEM specimen preparation.

The Advanced TEM Specimen Preparation Workshop exhibited a selection of advanced techniques for preparing TEM specimens and started with an introduction lecture: “Advanced Specimen Preparation Techniques for TEM”. The printouts of the introduction lecture slides were handed out to the



participants. Notably, the program included equipment demonstrations as well as practical hands-on laboratory experience for the participants under the guidance of staff members of the StEM, demonstrating following methods:

- Ultramicrotomy (UM)
- Focused Ion Beam (FIB)
- Ion Milling (IM)
- Automated Tripod Polishing (Tripod)
- Metallographic Pre-preparation (MP)

The participants of the workshop were divided into four groups for the practical hands-on sessions, and the practical sessions were conducted in parallel. At the end of the workshop, in addition to the TEM specimen preparation equipment experiences, the participants had the opportunity to visit three unique TEM installations at StEM. The workshop was attended by 15 participants (six female, nine male) from nine countries: France (1), Germany (4), Israel (2), Poland (1), Portugal (1), Slovenia (1), Spain (1), Sweden (1), Switzerland (1), and United Kingdom (2). Both the participants and the organizers were extremely satisfied at the end of the course after 4½ very work-intensive days and said goodbye to each other with new contacts and new ideas.

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