Project 5

Repeatability of high angular resolution electron backscatter diffraction (HR-EBSD) analysis for elastic strain measurements

Objectives

Compare different analysis methods and software packages on identical experimental data from a Si-SiGe semiconductor candidate reference material with known elastic tetragonal strain.

Background

High angular resolution electron backscatter diffraction (HR-EBSD) is a scanning electron microscopy (SEM) based technique to measure elastic strains and lattice rotations in crystalline materials using image analysis of diffraction patterns. Multiple image analysis methods are available through commercial, open-source and in-house software packages.

HR-EBSD application areas include residual stress and geometrically necessary dislocation density measurements in semiconductor devices and structural materials such as metallic polycrystals where these properties influence the device of materials behaviour.

Standardisation needs

This study will provide pre-standardisation information for a potential new HR-EBSD standard in ISO/TC 202:

- Reproducibility of HR-EBSD analysis using different image analysis methods and software packages;
- Sensitivity of the measurand to tunable calculation parameters within each method.

Measurement methods

Participants will use their own analysis methods on the same set of experimental data - EBSD line-scans acquired from a set of candidate reference materials (RM 8191) for HR-EBSD strain measurement developed by NIST.

Work Programme

HR-EBSD data acquired by NPL and NIST will be sent to participants along with a measurement reporting template.

Participants will measure elastic strain using their own HR-EBSD analysis software and in-house protocol and return the completed measurement report.

Deliverables and Dissemination

We expect the following deliverables:

- Report published by the National Physical Laboratory, and paper submitted to a relevant peer-reviewed journal. Participants and software methods will be anonymised where possible.
- Findings presented at the ISO/TC 202 Plenary meeting in 2025 and other relevant scientific meetings.
- Submission of a draft Technical Specification to ISO/TC 202 Microbeam Analysis.
- A follow-on study based on the results of the current ILC, potentially on an industrially relevant system, such as residual stress measurement of metallic polycrystalline materials.

Call for Participation

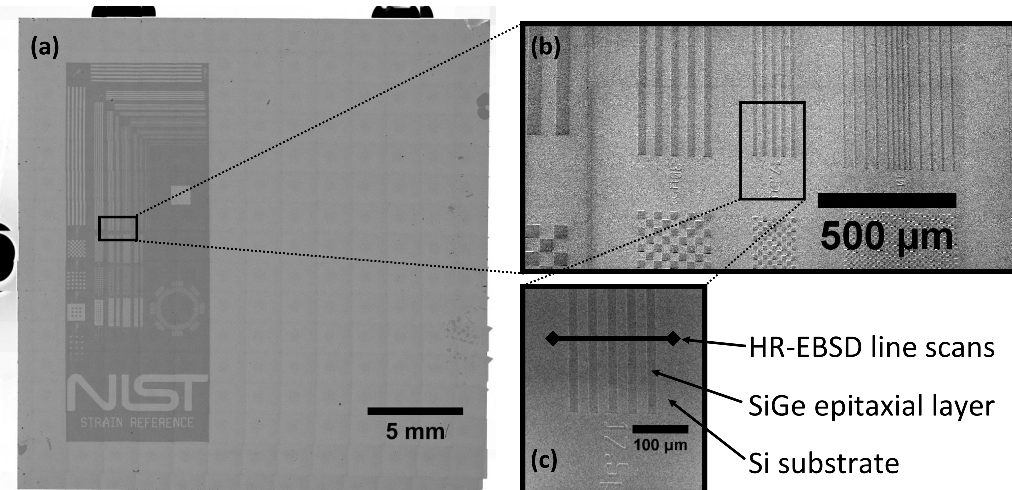

Figure 1 (a) RM8191 Si-SiGe candidate reference material developed at NIST; **(b)** Si-SiGe lines with tetragonal elastic strains; **(c)** HR-EBSD line scan region of interest on 17.5 µm lines.

International Participation

Current participation includes volunteers from countries from multiple continents. Additional participants are welcome to join the ILC.

Participants need to be skilled operators with access to their own HR-EBSD analysis software.

Funding

Participants fund their own involvement in the project.

Project Status

The project is due to start in August 2024 for a duration of 9 months.

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