

APLUS

Development of Standard Protocols for the Analysis of Atom Probe Data to support Improved Modelling & Mechanistic Understanding of Radiation Damage in LWR

OBJECTIVES

Ensuring the reliability and optimised functionality of structural components such as the reactor pressure vessel (RPV) and core internals depends on the development of mechanistic understanding of the effect of radiation damage on physical properties. This issue was the scope of several recent Euratom funded projects like PERFECT, PERFORM60 and LONGLIFE. These projects have demonstrated the importance of obtaining microstructural data at, or near, the atomic scale and ensuring that the provenance of this data is sufficiently well understood so that modelling can be used to directly relate microstructural observations to properties and hence support structural integrity assessments. In the last decade Atom Probe Tomography (APT) has provided a significant fraction of the near atomic-scale information used to underpin the development of mechanistic models. Specifically APT provides essential information for benchmarking the outputs of electronic structure and atomistic calculations (density functional theory, molecular dynamics, Monte Carlo, etc.). APT is a rapidly developing microstructural technique and methods of data analysis have not been standardised yet. As a result it is extremely challenging to compare APT data obtained from different research groups and for modellers to understand the inherent uncertainties of experimental data provided to underpin their models. The output of this project is a set of standard protocols for analysing atom probe data. The new protocols enable direct comparison of APT data obtained from different laboratories, while enabling modellers to analyse the outcome of atomistic simulations consistently with experiments, allowing direct and fair comparison. Trends in microstructural development can be more readily observed, underpinning the mechanistic understanding of the resulting mechanical development and allowing the data to be used more efficiently for the calibration and simulation of experiments.

DESCRIPTION OF WORK

The technical work of APLUS is carried out in the following work packages (WPs):

- WP1: Define type of experimental measurements that are required to support modelling of radiation damage,
- WP2: Review of existing APT methods,
- WP3: Standard protocols for analysing atom probe data,
- WP4: Sensitivity analysis using simulated data to determine the accuracy of the standard protocols,
- WP5: Application of standard protocols to selected data from LONGLIFE and PERFORM60,
- WP6: Dissemination of results.

MAIN RESULTS / HIGHLIGHTS

- Review of modelling needs and APT capabilities (public),
- Definition of Protocols for analysing APT data (public),
- Dissemination of results: Organisation of workshop and presentation of results at conferences (public)
- Submittance of articles summarising project results to peer-reviewed journals (public)
- Report issued by SCK.CEN reviewing the experimental measures required to support the modelling of irradiation damage, and
- Report issued by NNL and GPM identifying what can be achieved by APT when studying irradiation damage

DURATION

1 April 2015 – 30 September 2016
18 months

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PARTNERS

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