Behaviour of ODS steels under extreme conditions

RECENT RESEARCH ACTIVITIES:

The addition of nanosized Y$_2$O$_3$ particles in steels for nuclear fusion reactors is an approach to improve performance at high temperatures (650-700 °C) and also to increase radiation damage resistance; however, the role of oxide nanoparticles regarding radiation damage mechanisms is still not fully understood. Thus, the main objectives of the PhD project are:

1. Understand what are the effects of high energy particles, He, H, D and T in two ODS steels, namely, ODS Eurofer (with 9% of Cr) and ODS 12 Cr; both steels containing 0.3% of Y$_2$O$_3$ particles.

2. Characterize the defects formed after exposure to radiation, where they are preferentially formed and, as a conclusion, what is the role of Y$_2$O$_3$ nanoparticles in the radiation embrittlement. Techniques to be used:
   - **Positron Annihilation Spectroscopy Doppler Broadening (PASDB)** → profile of defects in the steels, evolution of defects with exposure to high energy particles (He$^+$ ion beam, to mimic effects of neutrons) and temperature;
   - **Thermal Desorption Spectroscopy** → Characterization of He and H trapping sites;
   - **Small Angle Neutron Scattering** → Size distribution of Y$_2$O$_3$ particles;
   - **Atom Probe Tomography** → Composition of oxide particles after heat treatments and implantation;
   - **TEM** → Characterization of microstructure and oxide particles

3. Study the microstructural stability of these steels at different working temperatures and for different periods of time.

OTHER ACHIEVEMENTS:

- Poster presentation at M2i conference, Dec 11th and 12th 2017, The Netherlands;
- Poster presentation at conference Positrons Studies of Defects 2017, Sep 3rd – 8th 2017, Dresden, Germany;
- Master project supervision on “Radiation damage and thermo-mechanical simulations of a beam stopping device”, in development by the student Romy Welschen at CERN, Switzerland, and 3mE TU Delft. Starting period: September 2017.