

## **NOMATEN SEMINAR**

### **Accelerator testing for nuclear materials – the JANNuS-Saclay multiple ion beam irradiation facility**

<https://gotomeet.me/ncbjmeetings/nomaten-seminar>

**Wtorek, 4 maja 2021 g. 13.00-14.30**

#### **Speaker:**

**Dr Celine Cabet (CEA - Saclay, French Alternative Energies and Atomic Energy Commission)**

#### **Abstract:**

Ion accelerators have been used by scientists for decades to investigate radiation damage formation in nuclear materials and thus to emulate neutron-induced changes. Among the most stringent reasons for using ion-beams are the scarcity of neutrons sources and the ease of use: a high damage or a high implanted concentration is obtained over a very short time and the irradiated sample has no residual radioactivity, which dramatically curtails the global cost and duration as compared to in-reactor testing. Ion-beams allow also performing well controlled and fully instrumented experiments in terms of particle energy, dose rate, fluence... with little variation during the irradiation. This is of great value in an analytical approach. Coupling of two or three beams, use of heated/cooled sample holders, and implementation of in situ characterization pave the way to real time observation of microstructural and property evolution in various extreme radiation conditions more closely mimicking the nuclear environments. That's why, multiple ion-beam facilities have been commissioned worldwide.

JANNuS is a joint project between CEA, CNRS and Université Paris-Saclay, which is an active member of the French EMIR&A network (national network of accelerators dedicated to material irradiation and analysis). IJCLab operates the in situ 200 kV Transmission Electron Microscope coupled to an accelerator and an implanter, called JANNuS-Orsay. At CEA Paris-Saclay, the Service de Recherches de Métallurgie Physique (Physical metallurgy Lab) manages JANNuS-Saclay, the unique triple ion-beam in Europe. The facility allows the simultaneous irradiation with heavy ions (like Fe, W) for nuclear recoil damage and implantation of a large array of ions including gasses for well-controlled modelling-oriented experiments.

This seminar gives selected examples that illustrate the use of JANNuS-Saclay ion beams in investigating the radiation tolerance of materials for today's and tomorrow's reactors. This includes the drastic effect of solute addition on irradiated microstructure in nickel, influence of the dose rate on the precipitation in ferritic alloys, the role of irradiation in the oxidation resistance of zirconium alloys, or the development of extended radiation defects in uranium di-oxide and the evidence of a synergetic effect between nuclear and electronic energy losses.

**Bio:**

Celine Cabet holds a PhD in Materials science and engineering from University of Loraine, France (1999). Her main research interests include materials under extreme environments such as high irradiation and high temperature corrosion by hot gasses and molten media for applications in future nuclear systems and for fuel reprocessing. Since 2015, she is head of the JANNUS group, which operates the JANNuS-Saclay facility at the CEA Paris-Saclay.