

## Implementation of An Innovative Nuclearized SEM in CEA-Atalante Facility

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The CEA R&D on U-PuO<sub>2</sub> fuels was performed in LEFCA facility in CEA-Cadarache (France) until 2015. LEFCA R&D activities are transferred to Atalante facility in CEA-Marcoule. Within the frame of the TARRA project, the design of new scientific instruments is in progress. Among these equipment, the development of a new nuclearized scanning electron microscope (SEM) dedicated to sintered nuclear samples has been acted. This new SEM is equipped with an energy dispersive spectroscopy (EDS) and electron backscatter diffraction detectors (EBSD).

### Choice and study

**Technical choices.** The fuel characterizations laboratory (LCC) has a large experience on servicing processes of nuclearized SEM connected to a glove box (HOTLAB2016). The final choice of set up is a TESCAN model which is a mix between MIRA3-GM and MIRA3-AMU SEM types. The MIRA3-AMU has a huge and heavy chamber designed for large samples. The entire system is equipped with suspensions based on an active isolation system. The MIRA 3-GM is a classic SEM MIRA3 with the biggest chamber proposed in TESCAN standard. The nuclearization strategy was to adapt the AMU-frame to the GM-chamber connected to a glove box. Active Isolation systems were ensured the connection between the fame and the modified device. By this design (with some optimisations on the GM chamber), it is possible to get rid of SEM disconnection and pneumatic suspensions to maintain it. The absence of cooling system makes its implementation in the ATALANTE-L26 laboratory easier.

This SEM-FEG is equipped with SE Everhart-Thornley, YAG-BSE, SE InBeam and also with EDAX EBSD and EDS detectors. The EDAX technology was chosen for two different reasons. Firstly, the EBSD detector has a window on the SEM chamber that offers the capability to maintain the camera without any containment rupture (no need to nuclearize it). Secondly, ceramic windows (Si<sub>3</sub>N<sub>4</sub>) used on EDS detector seems to be promising material on radiation protection (it seems stronger than those in polymer). A shielded shutter has also been added to reduce the impact of samples radioactivity.

**Study.** The Project started in November 2016 to create the TESCAN MIRA3-ATA (ATA for ATAlante). Safety and security rules of Atalante facility have substantially influenced the MIRA3-ATA design (valves, check valves, filters, connectors, earthquake resistance ...). A 3D view of the final model is presented in the figure 55.

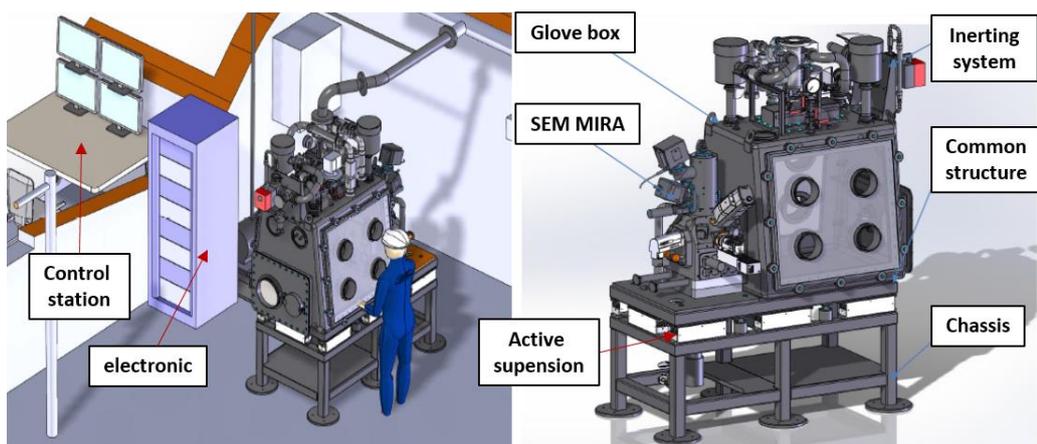


Figure 55: 3D representations of the MIRA3-ATA

### Realisation and implementation

Modifications of the SEM chamber were performed by TESCAN. The glove box, ventilation system and the frame have been manufactured by AEMCO Company. NEWTEC SCIENTIFIC has taken over the major modifications of the device.

Some key step of this project will be presented in the conference. To illustrate its implementation, the pictures of the figure 56 show the project progress at the end of May 2018.



Figure 56: Pictures of the SEM implementation in L26-Atalante in May 2018

### Results

A final part of the conference will present some results obtained with this apparatus after its commissioning.

### Reference

Jouan, G., Viro, M., Buravand, E. SEM analyses of powdered actinide compounds: Implementation in a hot laboratory. HOTLAB2016 proceedings