Beam degrader for analysis of volume of structural damage in materials

Really active within Technofusion and EUROfusion, CMAM (Centre for Micro Analysis of Materials - Universidad Autónoma de Madrid) has developed a chamber that includes a beam degrader to simulate a more homogeneous implantation profile and therefore, the volume of structural damage. The facility has been used for irradiation of ceramics for breeder blanket. This knowledge can be used in several other fields outside fusion, as radiobiology, electronics, batteries, vehicles, construction, packaging, plastics, textiles and food.

Description of the technology

The facility is a 5MV terminal voltage tandem accelerator which reaches energy ranges up to 10 MeV for protons, tens of MeV for heavy ions, and production of Pb and Bi.

Six beamlines allow large samples to be measured in air, while offering the possibility of 2D mapping and irradiation of the sample with a raster, elemental quantification of isotopes.

The analytical techniques herein so-called “IBA techniques” are used to analyze the elemental composition (at different levels: elemental, molecular, spatial, depth…) of a sample. Each line is handled by an assigned supervisor and technical personnel who will support users in the entire process.

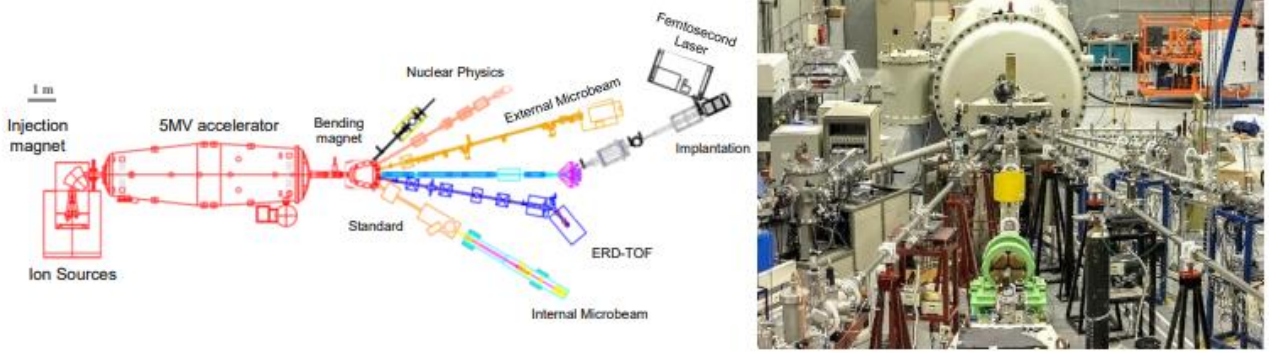


Fig. 1. Schematic illustration (left) and photo (right) of the CMAM's accelerator and beamlines.

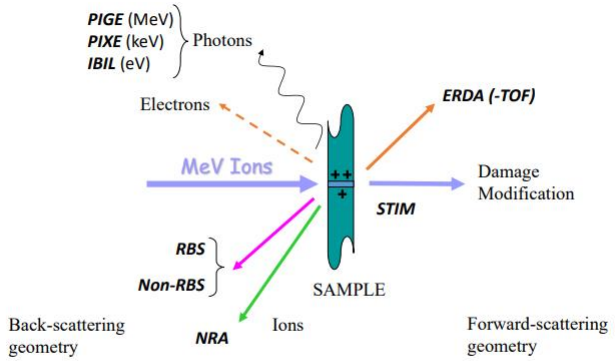
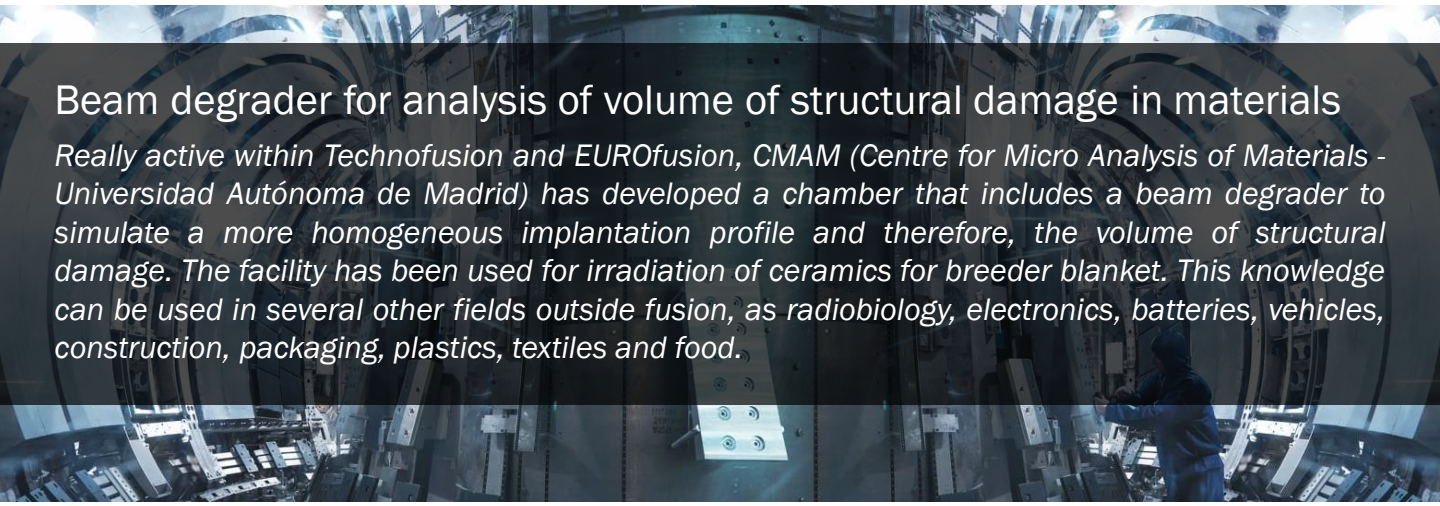


Fig. 2. Irradiated sample with an ion beam which, in turn, emits radiation in function of the energy of this incident beam. The emitted radiation will be collected and analyzed depending on the technique of interest.

IBA Technique	Ion (projectile)	Energy (Projectile ion)	Detected particle	Depth resolution	Detection limit
RBS	He	2 MeV	He	3-5 nm	1% - 100 ppm
ERDA	Si, I, Au	20-50 MeV	Target atoms	50 nm 3 nm (TOF)	1% - 100 ppm
NRA	H, D, He	1-5 MeV	H, D, He	1 - 10 nm	0.1% - 100 ppm
PIXE	H	3 MeV	X rays	-	ppm
PIGE	H, D, He	1-5 MeV	γ rays	-	0.01%



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Innovation and advantages of the offer

- Simulate the effect of an environment at different doses and temperatures on the radiation resistance of different materials
- Compatible with large size of sample
- simulate a more homogeneous implantation profile and therefore, the volume of structural damage
- Large conditions of use behavior prior to and after undergoing to extreme conditions (irradiation, corrosion,...)

Non-fusion Applications

Competencies developed trough this facilities can be used in a wide range of applications for the development of innovative, sustainable materials for key components in the most diverse sectors, such as electronics, batteries, vehicles, construction, packaging, plastics, textiles and food on an unprecedented level.

EUROfusion Heritage

The Centre for Micro Analysis of Materials (CMAM) is a research center belonging to the Universidad Autónoma de Madrid (UAM). CMAM is part of the TechnoFusion project in which Spanish institutions and facilities collaborate towards the development of fusion materials and related technologies. CMAM is also supported by EUROfusion on different workpackages.

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