

Focused ion beams: ion microscopy from extracted beams Lorenzo Giuntini^{1,2}

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Interactions of MeV beam particles with atoms and nuclei of a target induce the emission of characteristic radiation, the energy of which provides signatures of the compositional and/or structural properties of the target; Ion-Beam Analysis (IBA) techniques, based on the detection of such radiation, enable characterisation of samples of interest in many fields, such as, for example, material, environmental and earth science, cultural heritage, biology and medicine.

External beams, obtained by extracting the beam particles in atmosphere through a very thin window sealing the beamline, are very attractive as they allow for non-destructive and non-invasive characterisation of the sample under investigation, with ease of handling, moving and monitoring the target and no dead-time due to pump-down and refill of the vacuum chamber.

External microprobes have made it possible to obtain probes in the micron range by adopting strong focusing lenses, ultra-thin windows for beam extraction, and short/ultra-short external path of beam particles in light gases. External microbeams have also made possible the use of IBA techniques, e.g. BS, ERDA, STIM and IBIC, scarcely or not used at all in milli-beams set-ups. External scanning microprobes + IBA techniques have enabled the non-destructive/non-invasive characterisation of samples with high spatial resolution, which, for thick samples, can be comparable with that achievable with in-vacuum set-ups.

In the first part of the lecture we will analyze in detail the setting up of an external microbeam, focusing the attention on the problems to be solved and on the available solutions. In the second part, we will compare ex-vacuo and in-vacuo IBA techniques.