PIXE (Particle Induced X-ray Emission)

The ion beam from the accelerator creates inner shell vacancies by ionization. When the vacancy is filled by atomic de-excitation, characteristic X-rays are emitted. By measuring these X-rays with a high-resolution energy sensitive detector (normally HPGe) a fingerprint of the elemental content and their absolute amount in the sample is achieved. The method is very sensitive, multi elemental, non-destructive and can be used both with a focused and non-focused beam. The PIXE method, complemented with techniques described below, is one of a few techniques that allows a quantitative analysis in a (sub)microscopic scale where the distribution of different elements also directly can be visualised as quantitative elemental maps. It is this characteristic that makes the technique so interesting to apply in different fields of (life) sciences and that are illustrated in the list of collaborating projects and interdisciplinary publications.

RBS (Rutherford Back Scattering)

Traditionally this method is based on elastic scattering of alpha particle on nuclei in the sample. By the laws on conservation of momentum and energy the energy of the backscattered particle is a function of the mass of the target nuclei and hence by measuring the energy the mass can be deduced. The technique is often used in the study of thin films and by adding effects of energy loss of particles in matter, the structure of complicated samples can be entangled.

NRA (Nuclear Reaction Analysis)

For some nuclei, especially low-Z, there is a non-vanishing possibility for inelastic nuclear interaction. The results of these interactions are often very characteristic, but only at certain ion beam energies (resonance behaviour) they are useable. By measuring suitable parameters, either particles or γ-radiation, valuable information about these elements can often be achieved.

STIM (Scanning Transmission Ion Microscopy)

As an ion beam passes a sample it loses energy in a very controlled way. By measuring the particle energy after the sample it is possible to calculate the amount of mass passed. If the beam is scanned across the sample, a picture of the mass distribution in the sample on a sub-µm scale can be achieved.

μ-Tomography

If measuring the lateral distribution from a sample in a number of different angles and then applying a tomographic reconstruction algorithm a 3D image of the sample can be achieved. This technique can be used for any of the IBA techniques but the most common is to study density variations with STIM.

Ion Beam Lithography

As in all lithographic techniques a radiation sensitive resist is radiated in a pattern and subsequently processed chemically for development. The advantage of ion beam lithography is the large penetration depth in conjunction with the straight path of the particles, which makes the fabrication of high aspect ratio structures possible. Another advantage is the mask-less fabrication technique, which makes it very flexible.

Single Ion irradiation

Hitting samples in designated spots with single ions is interesting in a number of applications, e.g. single event upset in electronic devices or the response of living cells to a few counted ions. A set-up is operating with a very low beam current (<1000 particles/s), allowing low dose experiments on selected cultured cells to be performed.