Scanning Electron Microscopy and EDS analysis (SEM EDS)

SCIENCE ET SURFACE
Filiale de SERMA TECHNOLOGIES

SPECIFICATIONS

- Secondary electrons or backscattered electrons **images** (topographic and chemical contrast) with a lateral resolution of 1 nm (magnification up to 200 000)
- **EDS** (Energy Dispersive X-ray analysis) **chemical analysis**:
  - **Qualitative elemental analysis**: all elements detected , except H, He, Li, Be and B
  - Detection limit about **0.5 atomic %,** depending on the element and the matrix
  - **Quantitative** analyses (accuracy: 10-20 %)
  - Analysis depth: from 1 to 5µm, depending on the matrix and the acceleration voltage
  - **No chemical information** on detected elements
  - High Vacuum analysis pour for solid samples
- **Non destructive testing**, for all type of samples (necessity of a conductive coating for insulating samples on conventional SEM equipment)

SEM PRINCIPLE

The sample surface is scanned with a focused beam of monokinetics electrons (accelerated between 1 and 30 kV). The electrons interact with atoms in the sample, producing:

- Backscattering of high-energy electrons of the primary electrons beam (elastic scattering interaction)
- Production of secondary electrons that are ejected from conduction or valence bands of the specimen atoms (inelastic scattering interactions). These electrons have low energy (<50 eV)
- Photons (characteristic X-rays that are used for elemental analysis) Auger electrons ....

Secondary and/or backscattered electrons are collected, the position of the beam is combined with the intensity of the detected signal to produce an image of the sample surface. Contrast is related to the type of electrons, of the chosen acceleration voltage and of the nature of the sample atoms. Following contrasts are observed:

- **Topographic contrast** (lThe brightness of the signal depends on the number of secondary electrons reaching the detector. Thus steep surfaces and edges tend to be brighter than flat surfaces, cavities are dark, etc.
- **Chemical contrast :** heavy elements (high atomic number) backscatter electrons more strongly than light elements (low atomic number), and thus appear brighter in the image, BSE electrons are used to detect contrast between areas with different chemical compositions

EDS PRINCIPLE

The interaction of electrons beam with the sample lead to the production of X photons (desexcitation process). EDS chemical analysis consists in detecting X photons emitted from the sample surface with a dedicated detector

When the electron beam hits the inner shell of an atom, it removes an electron from the shell, creating a positively charged electron hole. When the electron is displaced, it attracts another electron from an outer shell to fill the vacancy. As the electron moves from the outer higher-energy to the inner lower-energy shell of the atom, this energy difference can be released in the form of an X-ray.

Thus, The energy of this X-ray is unique to the specific element and transition:

- Possibility to realize elemental analysis
- Quantitative information: area above the peak element is proportional to the number of excited atoms.