Technical Description: X-Ray Fluorescence instrument

What is an XRF instrument?

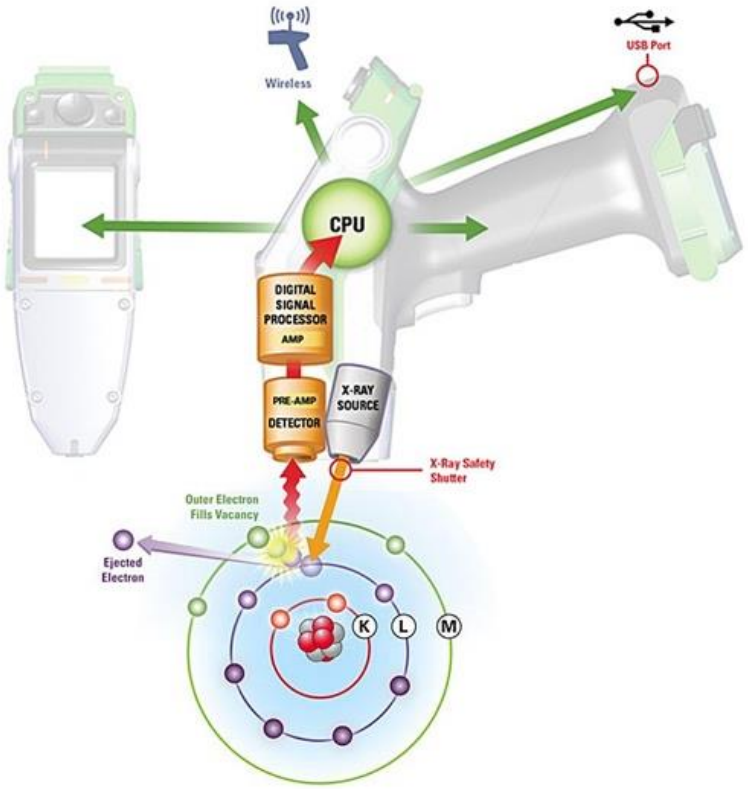
It is an expensive flashlight that is used to determine the elemental composition of a material. X-ray fluorescence is atoms emitting their characteristic colors from the inter electron structure. Every element has a characteristic electron structure. When inner shell electrons are ejected from an atom, electrons from shells with less binding energy fill the holes and may release x ray radiation equivalent to the difference in energy between the level the electrons came from to that which they went. The x ray radiation released during these transitions is characteristic to the element and has a specific energy (± 2 eV) depending on the transition made within the atom. By bombarding a sample with radiation that exceeds the binding energy of the electrons in the atoms of which the material is composed of and detecting the energy and number of resultant characteristic x rays emitted from each element, it is possible to determine the composition and proportional concentrations of those elements.

How does it work?

It shoots a photon from the light source, which is controlled by the user. This photon interacts with the inter-electrons in the atoms. When the electron in the inter shell in an atom absorbs the photon that is higher in energy than the binding energy, the electron leaves the atom. When an electron leaves an inner shell, the atom becomes excited and wants to fill the vacancy, so an electron from a higher shell drops down to fill that vacancy. When an electron drops from a higher to a lower shell, the energy difference between the shell is released as a photon exactly equal that energy difference.

What are the most important parts?

XRF instruments have several separate components that all serve their own function in the process of recording X-ray fluorescence. The main components in terms of functionality are the X-ray tube system, collimators, filters, detector and signal processing hardware and software.



X-ray Tube

Electrons are generated and accelerated to high speeds and then bombarded a target usually composed of a pure metal (e.g. W, Mo, Cr, or Rh). Upon reaching the target the electrons either interact and ionize the target, creating characteristic x-rays, or are decelerated upon nearing the nuclei, creating a Bremsstrahlung continuum.

Filter

It can be placed between the tube and the sample to remove undesirable background radiation below a certain voltage.

Collimator

They are usually circular or a slit and restrict the size or shape of the source beam for exciting small areas. Collimator sizes range from 12 microns to several mm.

Detector

It is used to convert incoming x-rays into proportionally sized analog pulses that are then converted by a digital pulse processing system to information that can be read by a computer and displayed on a spectrum. see and report the color or energy of the photon emitted from the atom.

Conclusion

This instrument is starting to get used in scientific research because it has several advantages over other spectrospy techniques. It is nondestructive, fast (under 60 seconds), and is easy to calculate concentration from the raw data.