Rapid and Non-destructive Studies of Chemical Speciation, Chemical Composition, and Atomic Spectroscopy by Wavelength Dispersive X-ray Fluorescence Spectrometer

Kishore B. Dasari, Ki-Man Lee, Yong Hyeon Nam, Jong-Hwa Moon, Gwang-Min Sun*

Neutron and Radioisotope Application Research Division, Korea Atomic Energy Research Institute, Daejeon, Republic of Korea
E-mail: gmsun@kaeri.re.kr

Keywords: dispersive crystal, Atomic structure, X-ray diagram lines, Low Z elements speciation, Chemical composition

High resolution X-ray emission spectroscopy using dispersive crystals helpful to study of atomic structure including speciation of light elements and chemical composition of samples [1]. Non-destructive analytical methods of X-ray absorption spectroscopy (XAS) and X-ray photoelectron spectroscopy (XPS) are highly demand for the determination of speciation analysis. But it needs big scale laboratory facilities such synchrotron accelerators. In the present study, we wish to establish the lab scale high resolution wavelength dispersive X-ray fluorescence (WD-XRF) spectrometer for speciation analysis of various matrix samples particularly for light elements. Moreover, recent developments in WD-XRF (i.e. high resolution crystals) have extra capabilities in terms of stability to produce the high accurate results at low $mg.kg^{-1}$ range (0-100 $mg.kg^{-1}$) and applicable to various matrixes includes liquids and semi liquids. Thus, WD-XRF machine was deployed to supplement elements in reference materials that are difficult to analyze with NAA and ID-MS. We installed a Bruker S8 Tiger sequential WD-XRF machine which has excellent properties such high sensitivity, qualitative, quantitative, multi elemental analysis technique and non-destructive. It has an ability to detect the all most all elements in periodic table down from Be to Am. The maximum voltage and current of X-ray in the beam tube are 60 kV and 170 mA with high stability of the tube (±0.00006 %). It has many advantages over Energy dispersive XRF in terms of lower detection limits, low Compton background. The sequential WDXRF spectrometer consists of moving detectors mounted on the goniometer are proportional counter efficiently measure light elements from Be to Cu (0.1 keV ~ 8 keV) and scintillation counter efficiently measure modern and heavy elements from Sc to U (> 4 keV), 9 primary X-ray beam filters, 4 collimators, 8 analyzer crystals with 0.024º step scan [Fig.1]. In the present study, preliminary results of chemical speciation of light elements, chemical composition and basic atomic transitions were demonstrated using WD-XRF.

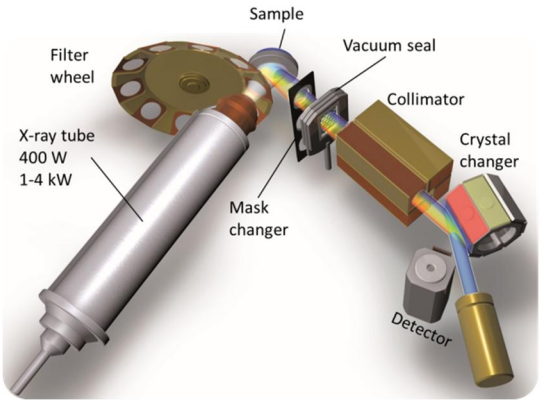

Fig.1: Internal structure of WD-XRF

중성자·동위원소응용연구부/2020-11-11 15:05