Second Stage/ Radiation Physics Lab

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Characteristic X-rays of molybdenum

Lecture 3

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The aim of this experiment:

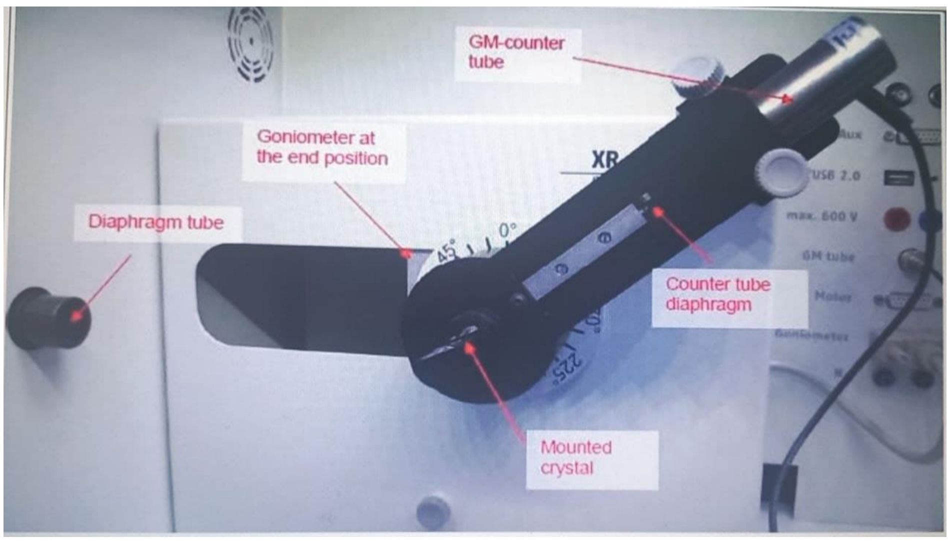
Spectra of X-rays from a molybdenum anode analyzed

The device used in this experiment:

1-Geiger-Muller counter tube

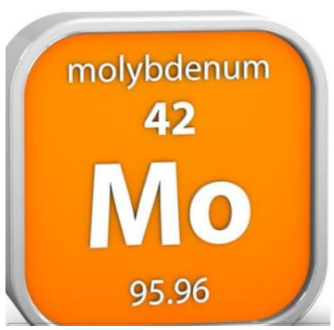
2-Goniometer with two independently working stepper motors for the precise angle positioning of a sample and a detection.

3- Diaphragm tube for the monochrome of molybdenum x-rays



Theory:

What is Molybdenum: is a chemical element in the periodic table of elements. It is represented by the symbol **Mo** and has the atomic number 42. Molybdenum is characterized by its high mechanical and thermal properties, which makes it an important material in many productions, such as steel, electronics, chemicals and energy. Molybdenum is found in nature in the form of minerals such as molybdenite, hematite. The amount of molybdenum in the earth's crust is relatively small, but it can be extracted from the ground through taking out operations. Molybdenum is used in many important applications, such as the steel production, heat and corrosion resistant alloys, electronics, nuclear power.



Characteristic X-rays are produced when inner-shell electrons in an atom are ionized, releasing energy in the form of X-ray photons with specific energies corresponding to the difference in energy levels between the two shells involved. The energies of the characteristic X-rays depend on the atomic number of the element.by comparing the energies of the characteristic X-rays emitted by the sample to known values for molybdenum, this technique can be used to analyze the elemental composition of a wide variety of samples.

If the inter planar layout d is known, the wavelength λ can be determined with the assistance of the glancing angle θ**. the glancing angle**: The angle made by the incident ray with reflecting Surface The energy of the radiation then results from:

$$E = \frac{hc}{\lambda}$$

From Bragg's Law : $\lambda = \frac{2d \sin\theta}{n}$

$$E = \frac{n.h.c}{2d \sin\theta}$$

Where:

E:the energy

θ: the glancing angle

d: The distance between the levels

λ: wave length.

n: number of atoms

h: Planck's constant

The method of work:

1-Connect the goniometer and Geiger-Muller counter tube to their respective sockets in the experiment chamber.

2-The goniometer block should be placed with the analyzer crystal in the final position on the right side.

3-Fasten the Geiger-Muller meter tube to its bracket at the rear stop of the guide rails.

4- Do not forget to install the diaphragm in it In front of the counter tube.

5- Insert the diameter diaphragm tube into the beam outlet of the tube socket X-ray beam collimator unit

Calculation:

The interaction of X-rays with molybdenum can be described mathematically using the laws of quantum mechanics. When X-rays with sufficient energy are incident on a molybdenum atom, they can interact with the electrons in the atom, leading to various possible outcomes, such as:

1. Photoelectric effect: In this process, an X-ray photon interacts with an electron in the inner shell of a molybdenum atom, causing the electron to be ejected from the atom, this process is characterized by a sharp decrease in the intensity of the X-rays as they pass through the material.

2. Compton_scattering: In this process, an X-ray photon interacts with a loosely bound outer-shell electron in a molybdenum atom, causing the electron to be ejected and the X-ray photon to lose energy and change direction. This process contributes to the attenuation of X-rays in the material and is more possible to occur at higher X-ray energies.

3-The interaction of X-rays with molybdenum is a complex process that involves absorption, scattering, and other physical processes. The mathematical and physical descriptions of this interaction are important for understanding and analyzing X-ray ranges and for applications such as X-ray diffraction, X-ray fluorescence, and X-ray imaging.