Nanoobjects microscopy

Microanalytical X-ray facility in IAP NASU

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X-ray techniques remain popular in studying the elemental composition and structure of various materials. Advanced high-intensity X-ray sources and X-ray optics extended the range of applications up to a submicron level.

Institute of Applied Physics NAS of Ukraine have been developing and constructing a multi-purpose facility for X-ray study of substances and materials.

A multipurpose research X-ray facility has been developed at the Institute of Applied Physics NAS of Ukraine. Construction of a test-bench is the underlying concept for a classical EDXRF analysis, X-ray fluorescent analysis with a secondary target application, and X-ray radiography. Major high voltage and vacuum units were taken from the SELMI electron microscope removed from service (Ukraine). As electron beam parameters did not meet the specifications (current of a focused electron beam is less than 1 mA), a new electron source was required. Therefore, a new cathode unit was developed on the basis of a three-electrode gun with an indirect filament cathode. A conventional electron-optical system with some improvements allowed an effective transportation of an electron beam into an interaction chamber (about 80% of generated electrons impinge a target) and a production of an electron beam spot less than 30 μm on a convertor target.

The proposed facility is advantageous in quick changeability of anode material, accurate regulation of current and voltage of an electron beam, and variation of X-ray intensity via turning the convertor-target about its axis without changing current and voltage. All this opens a prospect for a standardless analysis.

X-ray fluorescence analysis was performed with a converter target, a sample holder, and a Amptek XR-100SDD detector installed in a chamber. Such arrangement provided geometry of a conventional X-ray fluorescence spectrometer with an X-ray tube of unique characteristics. Radiography appliance was additionally mounted. An X-ray source, a sample, a fluorescent screen (MCI Green 400) and a video camera were placed in a line. Small linear dimensions of X-ray generation zone permitted resolution higher that 50 μm. The experimental result is shown in a figure. A SIOC-8 microchip was chosen as a test sample.

Fig. 1. X-ray image of microchip

Application of a goniometer sample holder and mathematical algorithms provides not only an X-ray image but also a 3D visualization.

Big vacuum chamber makes it possible to test a model of a microfocus model with a secondary target. It is a combination of a standard model with a secondary target and polycapillary X-ray optics.