ostec corporate group

future's in the making

MicroXRF analysis of the printed circuit board

XROS MF30 – laboratory x-ray microscope-microprobe for studies of the objects by the methods of the optical microscopy, radiography, local element XRF microanalysis with possibility of the element mapping. Using a microscope, a sample of up to 400 mm in size along the Y axis and of unlimited size along the X axis (max. scan area 150×150 mm; in the case of a larger area, the scanned areas can be stitched) and up to 105 mm high can be performed.

An overview video camera and two optical microscopes with magnification up to 200 times are using for accurate determination of the scanning area.

The central optical microscope with automated sharpness adjustment is combined with the axis of the microprobe (axis of the x-ray beam).

Local X-ray fluorescence microanalysis with the possibility of elemental mapping and X-ray studies can be carried out both separately and simultaneously.

Sample positioning accuracy is 10 microns.

The minimum diameter of the x-ray probe is 30 μm.

The range of simultaneously measured elements from ^{11}Na to ^{92}U.

Experimental details

Scanning interval	800 µm
Speed	800 µm/s
Measurement time	100 ms
Voltage	40 kV
Current	2 000 µA
X-ray tube	Mo anode
Atmosphere	air

Sample

According to IEC 62321-3-1-201 it is necessary to monitor the content of heavy metals in printed circuit boards. The document describes the screening analysis of five substances, specifically lead (Pb), mercury (Hg), cadmium (Cd), total chromium (Cr) and total bromine (Br) in uniform materials found in electrotechnical products, using the analytical technique of X-ray fluorescence (XRF) spectrometry. We apply microscope-microprobe **XROS MF30** for analysis of printed circuit board to map elements.

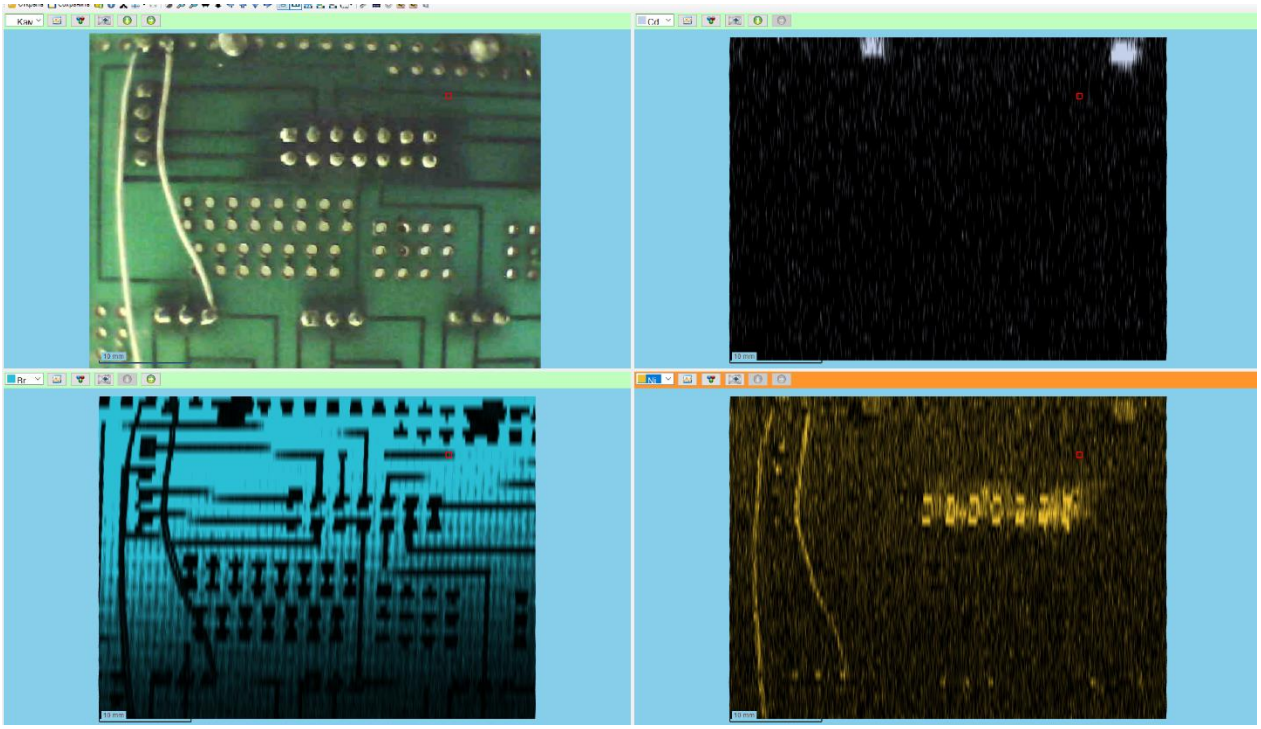

Fig. 1. The figure of the analyzed area as well as cadmium, bromine and nickel intensity distribution map

Fig. 1 contains the image of analyzed PCB area. The board has coating with bromine, which is visible on the bromine intensity distribution map. There are two screws on the PCB upper part. It contains significant content of cadmium and chrome trace elements (Fig. 2).

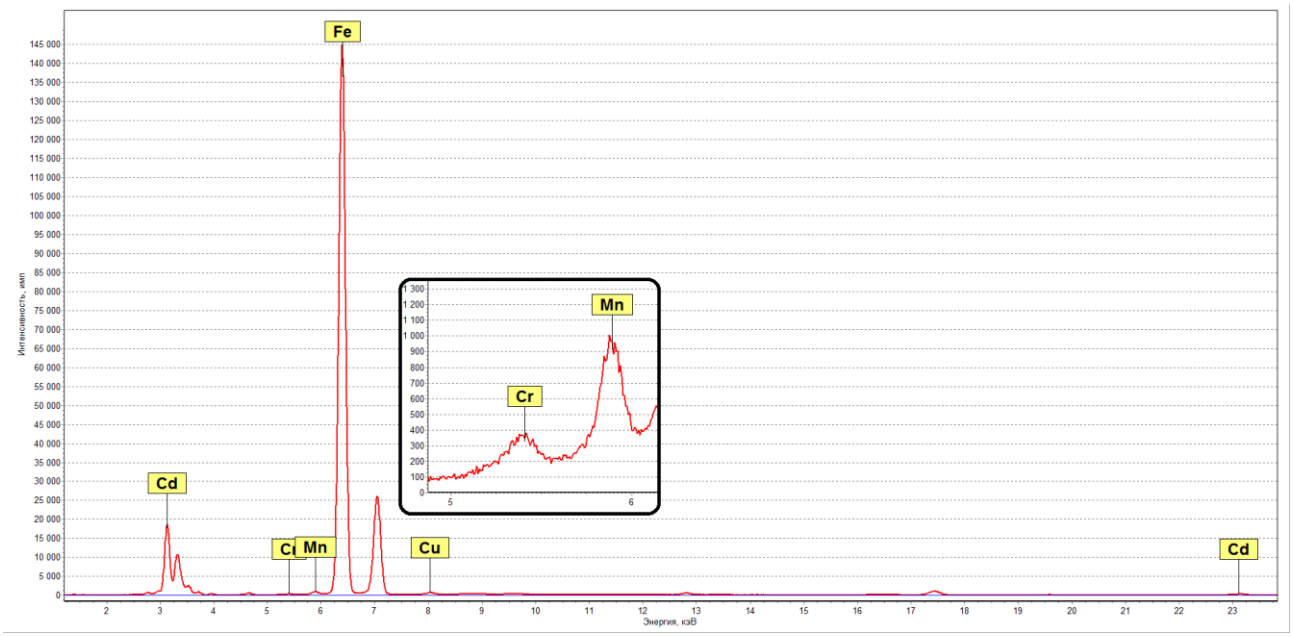

Fig. 2. Screw spectrum

One of the most important elements for monitoring is lead. As per IEC 62321-3-1-201 it is necessary to control its content in solder alloy and other PCB elements. On the lead, tin, copper and bismuth intensity distribution chart (Fig. 3) it is clear, that the images are not identical, which means that lead is present in various compounds. Contacts were brazed with solder, containing tin and lead. Moreover, circuit tracks also contain lead. There are two types of tracks: lead-bismuth and lead-copper ones. The measurements (100 sec. each) in additional points of the PCB were performed to improve statistical data. The spectra are on Fig. 4. The content of the elements was calculated by fundamental parameter method (Table 1).

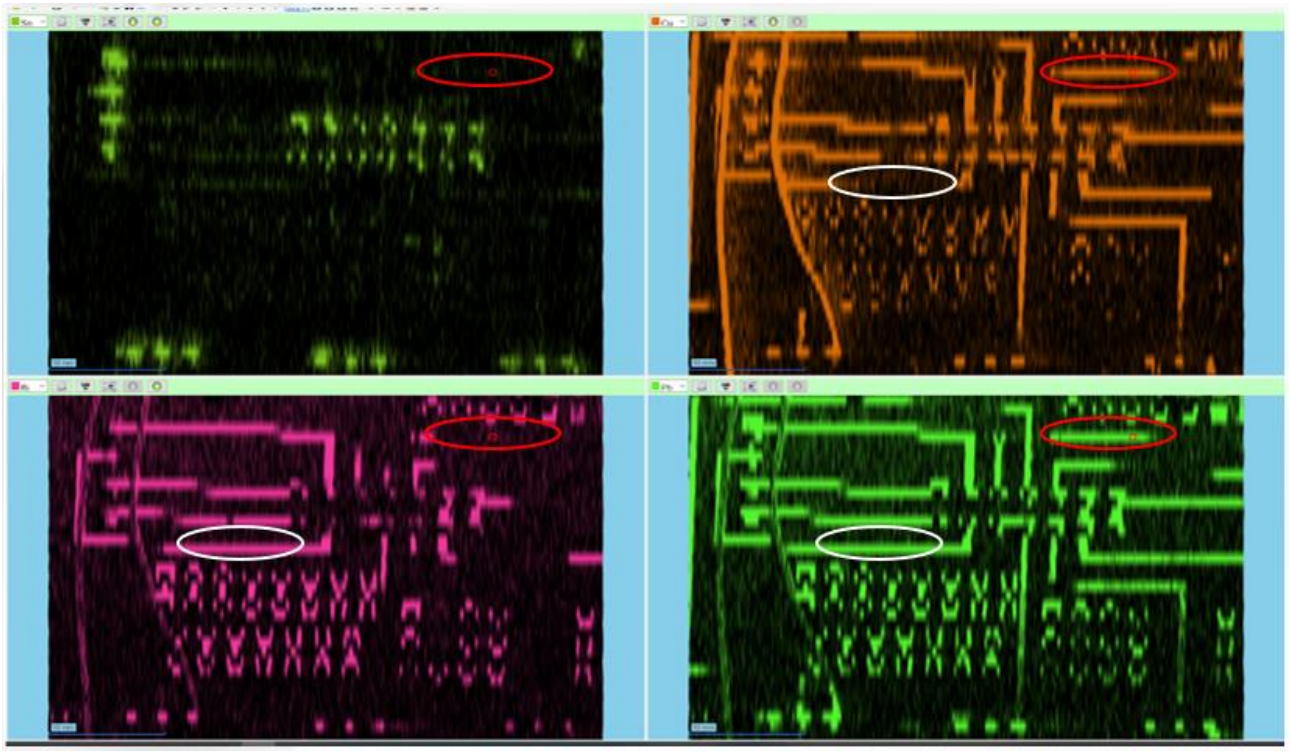

Fig. 3. Tin, copper, bismuth and lead intensity distribution maps. Lead-copper track is emphasized by red color. Lead and bismuth track - by white color

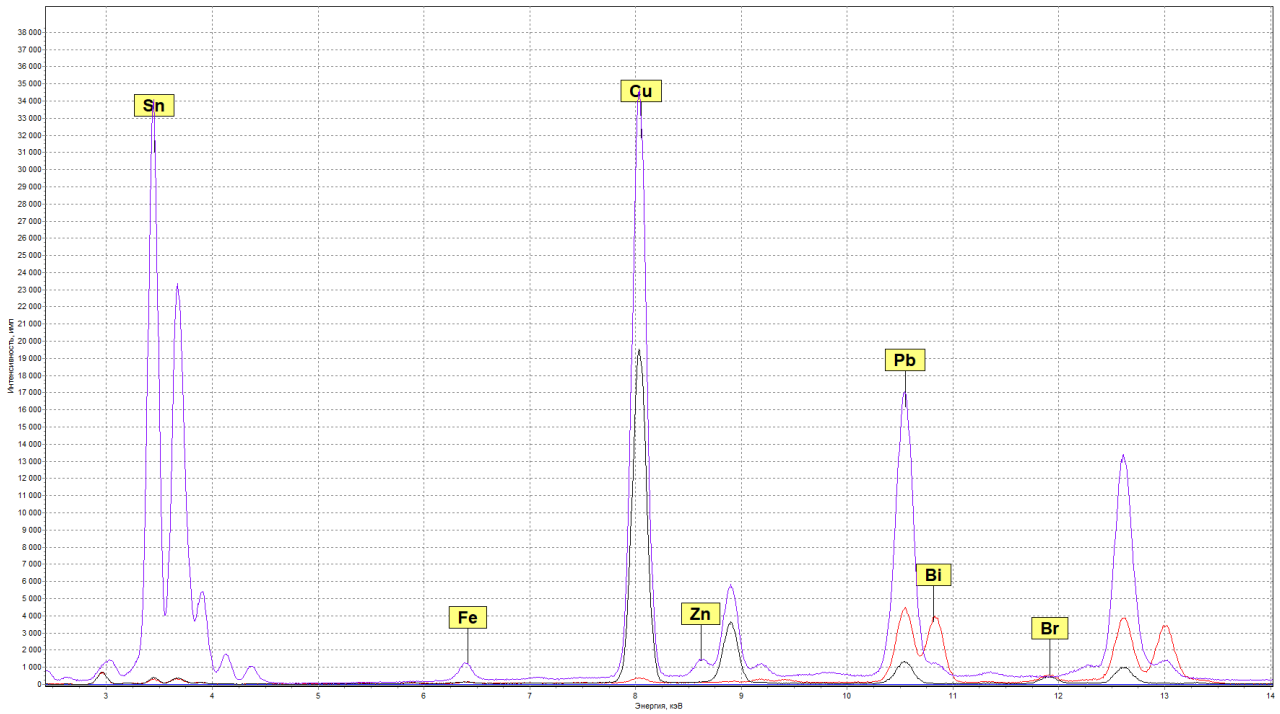

Fig. 4. The spectra of different areas of PCB: purple – solder alloy on contacts, red – lead-bismuth tracks, black – lead-copper tracks

Table 1. The results of fundamental parameter analysis (the sum of concentrations of visible elements is normalized by 100 %)

Object	Sn	Pb	Bi	Br	Cr	Cd	Fe	Ni	Cu	Zn	Au	Cl	K	Ca	Co	Mn
Copper-lead track	21.1	16.1	-	2.4	-	-	0.46	-	59.8	-	-	-	-	-	-	0.26
Lead-bismuth track	17.6	30.9	48.9	1.26	0.17	-	0.28	-	0.69	-	-	-	-	-	-	0.19
Tin	88.3	5.6	0.21	-	-	-	0.22	-	5.5	0.14	-	-	-	-	-	-
Screw	-	-	-	-	0.05	59.7	39.9	-	-	0.13	-	-	-	-	-	0.17
Background*	-	-	-	93.1	-	-	1.85	-	2.62	0.62	-	-	-	-	-	1.79
Wire	-	-	-	2.9	-	-	-	-	97.1	-	-	-	-	-	-	-
Nickel spot	0.45	-	-	-	-	-	0.35	68.2	24.0	5.5	0.86	0.25	0.24	0.18	0.08	-

** Light elements, which are not detectable by microscope are not considered, therefore the concentration of bromine in plastic PCB contains significant errors*

Conclusion

The analysis demonstrated the presence of traces of lead, chrome, cadmium, bromine in the PCB. These elements should be monitored according to IEC 62321-3-1-201. It was also determined their distribution through PCB. Semiquantitative analysis was done by fundamental parameter method.

Microscope-microprobe **XROS MF30** allows analyzing PCB by IEC 62321-3-1-201 with element distribution map.