Composite PXWR application for TXRF

1Loukianchenko E.M., 2Egorov V.K., 3Egorov E.V., 1Potrahov N.N.
1SPbGETU “LETI”, Saint Petersburg, Russia
2IMT RAS, Chernogolovka, Moscow District, Russia

X-ray fluorescence analysis in conditions of total external reflection (TXRF) is one of the most effective methods for the material elemental analysis, today. The fundamental feature of the method is the X-ray fluorescence excitation in surface layer of the studied object with thickness 3-5 nm. Inasmuch as the exciting volume of the object is limited by conditions of the total external reflection phenomenon, the radiation density magnitude of exciting flux is the critical parameter of TXRF spectrometry. The best device for TXRF exciting beam formation is the planar X-ray waveguide-resonator (PXWR), because it is a bonus unit in respect to formation of X-ray beams with increased radiation density [1]. Application of PXWR with simplest construction in combination with the compact TXRF cell [2] allowed to achieved pollution detection limits near \(4 \times 10^{-13}\) gramm at BSW-22 (Ag) X-ray source regime \(U=40\) keV, \(I=4\) mA. At the same time, the simplest waveguide-resonator is characterized by appreciable angular divergence near 0.1 degree. This deficiency can be eliminated by use the composite waveguide-resonator (CPXWR) idea [3]. It device captures an initial X-ray radiation flux in the angular interval \(\Delta \varphi\)-0.2 degree and forms its emergent beam with smaller angular divergence without its integral intensity attenuation. CPXWR is built by two PXWRs placed one after another and adjusted between them on distance in not excess of the interference field protrusion \(L_p = \lambda_0/8\Delta \lambda^2\), where \(\lambda_0\) is the wavelength of transported radiation and \(\Delta \lambda\) is the degree of it monochromatism. This expression defines condition of the partial angular tunneling of X-ray flux. Theory of this effect is not created, today. So, elaboration of CPXWR effective constructions suitable for use in TXRF is art which learns upon experience and scientific intuition. The work is discussed design of CPXWR solutions, TXRF data obtained with CPXWR application and experimental and construction difficulties connected with these devices fabrication. There are presented comparative data about Ag and Mo radiation beams formed by slit-cut systems and different waveguide-resonance constructions and TXRF spectra collected by these devices application.