EFFECTIVE PORTABLE SPECTROMETER OF PRECISE DEPTH SELECTIVE CONVERSION ELECTRON MÖSSBAUER SPECTROSCOPY FOR INDUSTRIAL APPLICATIONS

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The method of Depth Selective Conversion Electron Mössbauer Spectroscopy (DSCEMS) that undergoes currently its active development enables investigations of properties for material surface layers with Mössbauer nuclei. Due to its high depth resolution this non-destructive DSCEMS method may be useful in various industrial applications such as surface control of iron-containing materials. Yet available commercial and industrial laboratories equipped with DSCEMS installations operate with depth resolutions far from physical limit. High-resolution or precision installations that include electron spectrometer and nuclear gamma-resonance spectrometer such as described in [1, 2] are quite complex and ponderous. These installations do not meet requirements of their industrial/commercial use. For such applications one looks for a portable easily controlled installation with performance close to [1, 2].

While developing such portable installation it is more promising to use as basis a simpler installation [1] which has ratio sample size to electron spectrometer size of about five times larger than that in [2]. As a further development of [1], the paper presents an equal-arm version of a portable electron spectrometer with transverse heterogeneous sector magnetic field that assures twofold focusing. The spectrometer is equipped with a large-area non-equipotential source (a sample under investigation) and a position-sensitive detector similar to that one used in [3]. Here are the main characteristics of the equal-arm portable spectrometer: the equilibrium orbit radius ρ_o = 80 mm, the instrumental energy resolution 0.6 % at solid angle 1 % of 4π steradian, the area of non-equipotential electron source ~ 80 mm^2, registration with position-sensitive detector of ~ 10 % of the energy band.

Effective portable spectrometer assures obtaining Mössbauer date with depth resolution close to physical limit of the method. For measurements at conversion and Auger electrons with energies of about units of keV and above the achieved resolution comprises several nanometers within total depth of surface nanolayers of ~ 100 nm and more. For measurements at low-energy Auger and secondary electrons with energies up to ~ 0.5 keV the achieved resolution is about tenth fractions of a nanometer within total depth of surface nanolayers ~ 10 nm.

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