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Development of a new confocal-macro X-ray fluorescence spectrometer built on 3D printer

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For 3D analysis of elementary composition on surface and depth layers of objects with non-regular spatial shape a new type of confocal macro XRF (CM-XRF) spectrometer was designed and built. A simply constructed 3D printer was applied as the moving system for the basic devices of the XRF spectrometer. The SD detector and the low-power air-cooled X-ray tube (4W) mounted on a vertically moving console and the sample is fixed on x-y stage of the 3D printer that translates it in horizontal directions within 20 cm lengths. For both excitation and secondary X-ray beams were planned a new collimator system on the basis of Monte Carlo simulation, performed by MCNP6 software package, in order to create a macro confocal measuring set-up. The minimum step-size is 100 μm and the spatial precision of the positioning of each mechanical stages (x-y-z) of the 3D mechanical structure is about 5 μm. The minimum of the achieved diameter of the focal spot of the confocal measuring arrangement was found as 480 μm using aluminum tubes as collimator. The measuring confocal spot at the cross junction of the excitation and secondary fluorescence X-ray beams is positioned on the sample surface by application two laser beams and a built-in digital microscope. The positioning optical system together with the MC-XRF spectrometer are fixed on the horizontal arm of the 3D printer that is moved in vertical direction. The elements of XRF and optical positioning systems are mounted on additional mechanical moving stages for fine manual setting the confocal geometrical set-up. The analytical capability and geometrical resolution of the MC-XRF spectrometer were determined in x-y-z directions and the MC-XRF spectrometer was tested with some analytical application.

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Which ”Key Question” does your Abstract address?

NEW1.3

Topics

NEW1

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