X-ray Diffractometery Analysis of Coarse-Grain Substances Directly in Products

For comparison, let's look at the possibilities of typical x-ray diffractometers with divergent primary beam. To analyze coarse-grain materials with the help of such diffractometers it becomes necessary to increase distance to the object (fig.1).

Necessity of increasing distance during analysis pf coarse-grain substances in case of typical diffractometers

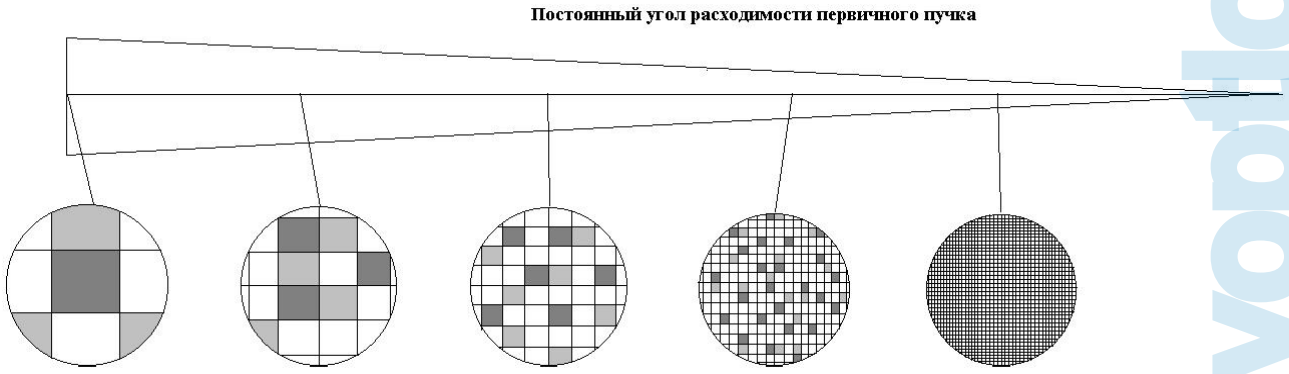


Fig.1

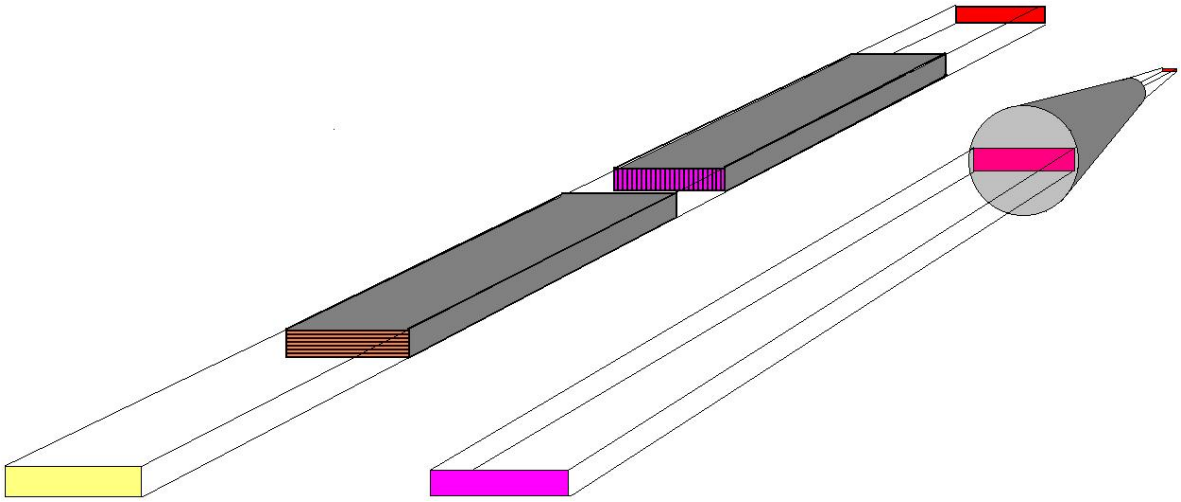
Hence, the diffractometer has to be equipped with a powerful x-ray source and a position-sensitive detector of a very large radius. It is natural to assume that some benefit can be achieved in using a parallel x-ray beam.

Let's look at the scheme used in stationary diffractometers with large linear focus of a powerful x-ray tube (5000W), goniometer radius of 0.5 meters, and forming crossing Soller slits for analysis of polycrystalline samples with coarse grain (fig.2). The loss of intensity in this case will make about 97%.

Use in x-ray diffractometers of «RIKOR-5» series of a low-power x-ray tube (10 W), a goniometer of 0.1 meter in radius, and a collimation system which is the Kumakhov polycapillary lens with output diameter of 15mm, allows creating a wide spatially-collimated beam of practically parallel x-rays with ~10^{-3} rad. divergence (fig.2).

This provides determining residual and effective stresses in parts featuring grain size of the order of several millimeters, the intensity loss being 80%. Such diffractometer becomes portable.

Intensity losses in case of polycapillary half-lens and in stationary diffractometers with large linear focus of a powerful x-ray tube (5000W), goniometer radius of 0.5 meters, and forming crossing Soller slits.



Focal spots after collimation systems

Fig. 2

Obtaining a wide parallel beam from small linear x-ray tube focus with the help of Kumakhov optics

The possibility of obtaining a wide parallel beam from small linear focus of an x-ray tube with the help of Kumakhov's optics is shown on the parallel bean formation schematic (fig.3), where 1- is half-lens input, 2 – is the half-lens output, 3 – are possible (adjustable in size) projections of anode spot, 4 – is the divergent x-ray beam produced by x-ray tube, 5 – is Kumahov polycapillary half-lens.

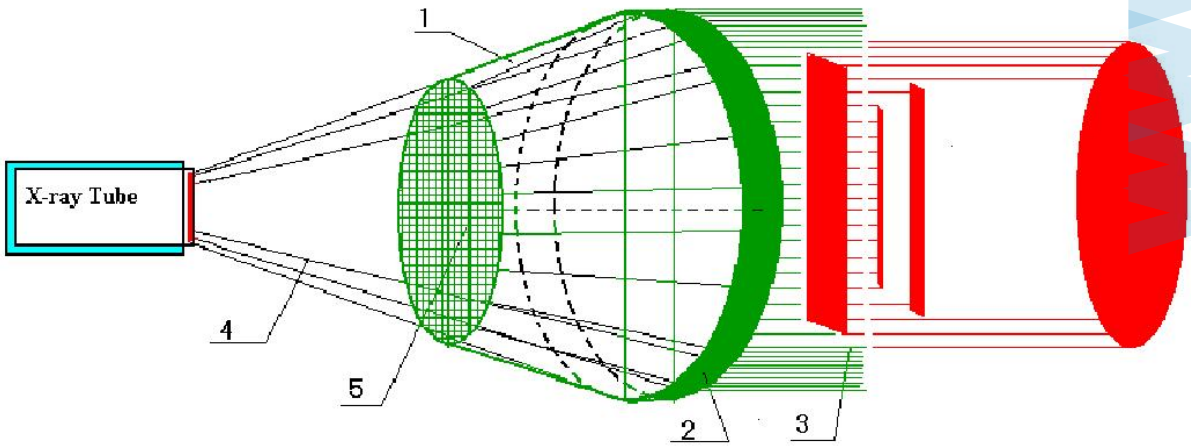


Fig.3