A METHOD OF X- RAY HOLOGRAM REGISTRATION FOR FRESNEL REGION

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A new hard X - ray hologram with using crystal Fresnel zone plates (ZP) has been described. An image of Fourier hologram for hard X- ray is presented. As shown practically, such ZP had advantages like small absorption, high efficiency and high spatial resolution.This study demonstrates for first time an imaging properties ZP for hard x-ray radiation using special geometry. Reproduction of hologram image using a phase zone plate for Fraunhofer region and retrieval the image in the Fresnel region by use of wavelet transform is a new technique. Problem is formulated as the recovery of lost phase information of an optical wave field from the recorded intensity in the Fresnel or Fraunhofer region. In classical optics a lens can be used for reproduction of hologram image. For hard X-ray optics a numerical methods can be used for reproduction of hologram. In our experiments we used ZP for recording Fourier holograms and numerical methods retrieval for reproduction of Fourier hologram. We recorded holograms from nano and micro size objects, which give a different phase shift from 0.1π to2π. The images of the test objects consisted of the word-combination “X - Ray Fourier hologram”. They were prepared on the silicon crystal membranes 2μm thick by electron-beam lithography and ion-plasma etching. The width of the letters is from 100 nm to 2 μm and the height is from 50nm to 30μm.The experiments were performed in micro focus sours beamline with the x-ray energy 8 keV. We created a computer program for theoretical study of object-lens system based on ZP. The program allowed simulation all properties of such system with limited number of zones. The calculation was based on the use of Kirchhoff propagator in a paraxial approximation and fast Fourier procedure. The intensity map inside the plane across the optical axis was calculated for each parameter, including the shift of the object and ZP across the optical axis. We recorded new holograms of nano and micro size objects for near and far fields. The hologram image after Fourier transformation was reproducible.

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