**Diffractive Optics developed for X-ray etching high efficiency mirrors and super-mirrors used both for X and Neutron radiations**

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Artificial periodic multilayers allows to produce High Reflectivity Mirrors which are the basement of X-Ray Optics. We will describe our sputtering system with high degree of reproducibility both in regard to the layer composition and the layer thicknesses. We will explain improvement of our magnetron sputtering. These improvements are of three kind. The first one is a new extremely precise method of calculation of the exact deposition rate using X-Ray diffraction. The second one is using a cooling substrate. The third one is a in situ analysis of the R.F. magnetron discharge using optical emission spectroscopy in order to prevent any change in the deposition rate. We will gives some results obtained in soft X-Ray Range around 1 Kev with a high degree of reproducibility. This extremely good reproducibility allows us to perform non periodic structures as super-mirrors used both for neutron and X rays. The principle of neutron super-mirror can be applied to x-rays. Bending super mirrors to focus x-rays at high energies can be used to provide specific energy. This W/Si super mirror showed a reflectivity of more than 30% for energies up to 65.5 Ke. Such non periodic structures can be tested with the appropriate radiation for which the super-mirror is designed but also using classical X-ray diffractometer at 1.54 A (Cu Ka line)

The numerical study of propagation of electromagnetic waves in the resonance domain can be adapted to the X-Rays and Neutron and the second allows measurements to compare the validity of theoretical models Lamellar gratings etched in a multilayer (LMG) are the basic type of Bragg-Fresnel optics. In this paper we describes important points in the fabrication, computer simulation, and testing of the LM's. They can be very interesting as a spectroscopic device with a relatively high dispersion and efficiency. We develop a rigorous theory of diffraction combined with the layer-by-layer differential integration numerical method. The agreement with experimental results obtained for a lamellar grating with several period and various etched depths in a W/Si multilayer is very good.

The main result is an increasing of the effective extinction depth (text) in short-period gratings which gives a possibility to increase the absolute diffraction efficiency of the LGM practically from 30% to 60% in the first order with a totally suppressed zero order.

Taking into account equation of focalisation, we use a convenient quick method to achieve a picture of a special mask for optics designed. First, we find a profile of this mask with MATCAD. Then, the data are transferred the photo mask to etch the multilayer. We will present some results of Bragg-Fresnel lenses calculations. The data will be applied for fabrication of optics based on grooved W/Si and Ni/Ti multilayers mirrors and neutrons super mirrors.