Diffractive/Reflection optical elements. From Bragg reflection to total external reflection.

Alexander Firsov[(1)], Anatoly Firsov[(2)], Alexander Svintsov[(2)], Alexei Erko[(1)]

(1) *Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Institut für Nanometeroptik und Technologie, Albert-Einstein-Str. 15, 12489 Berlin, Germany*
(2) *Institute of Microelectronics Technology and High Purity Materials RAS, Academician Ossipyan str 6, Chernogolovka, Moscow Region, 142432, Russia*

alexander.firsov@helmholtz-berlin.de

At the present time reflection zone plates working on total external reflection (focusing as well as energy-dispersive elements for 20 eV to 12 keV energy range) are starting to get more attention due to advanced surface polishing technology and possibilities of creating layouts in resist layer by either e-beam lithography or photolithography. Feasibility of finest design features as small as 40 nm (e-beam lithography) and total layout area as large as 2000 mm^2 and more allow one to create diffractive structures for a wide variety of applications: time-resolved experiments, scan probe experiments (micro fluorescence analysis) etc.

In August 2016 was the 30th anniversary of the first publication about the focusing properties of the diffractive element based on the reflection effect from profiled multilayer structure [1]. Later, Bragg-Fresnel diffraction focusing elements based on multilayer structures and crystals were effectively used at the DCI synchrotron radiation source at LURE for fluorescent micro analysis and micro diffraction experiments [2]. Focusing of a hard radiation at total external reflection by using the profile of Fresnel zones for the first time was demonstrated in [3].

New generation X-ray optical elements and for spectroscopy and monochromatization in the soft and hard X-ray ranges were developed and fabricated at the Helmholtz-Zentrum Berlin (HZB). These reflection zone plates at total external reflection (RZP) have been used in optical systems with synchrotron radiation at BESSY II [4], at free electron laser sources and the LCLS in Stanford [5] as well as in laboratory instrumentation - high harmonic generation sources [6] and scanning electron microscopes [7].

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