PS12.02.25 STATISTICAL APPROACH: TO COHERENT DIFFRACTION FROM A PERFECT CRYSTAL WITH A RANDOMLY DISTURBED LAYER. I. A. Varlantyan1 and J.-P. Guigay2. Institute of Crystallography RAS, Moscow, Russia, 2Laboratoire Louis Nel, CNRS, Grenoble, France

X-ray intensity diffracted by statistically deformed crystals is usually considered as the sum of a coherent \( I_{coh} \) and an incoherent \( I_{inc} \) components [1], which can be separated experimentally by using the technique of triple-crystal diffractometry. The present work deals with numerical calculations of the angular distribution of \( I_{coh} \) from a crystal with a statistical distribution of microdefects located in a surface layer, in the frame of the theory developed in [2]. The lattice spacing of the layer was taken slightly different from the lattice spacing of the perfect substrate. The statistical layer deformation is defined, according to [1] by a static Debye-Waller factor \( E \) and a correlation function \( g(t) \). We have used different models for \( g(t) \): an exponential model and a model corresponding to spherical amorphous clusters. In our calculations the coherence intensity \( I_{coh} \) diffracted by the substrate and \( I_{coh} \) diffracted by the layer correspond to different angular ranges because of the microscopic deformation of the layer. Our results show that \( I_{coh} \) depends strongly on the value of Kato's correlation length \( \xi \) and on the value of \( E \) only and practically does not depend on the model of correlation function. There was found and explained nonmonotonic behavior of \( I_{coh} \) as a function of parameter \( \xi \). The possibilities of independent measurements of \( E \) and \( \xi \) with the help of synchrotron radiation are discussed.


PS12.02.26 DIFFUSE X-RAY SCATTERING FROM ROUGH INTERFACES IN SPUTTERED W/Si MULTILAYERS. T. H. Metzger, T. Salditt, D. Lott, J. Peisl, Sektion Physik, University of Munich, D-80539 Munich, Germany

Amorphous W/Si multilayers (ML) have been produced by sputtering at varying Ar pressure. The evolving structure of the interfaces is investigated by diffuse x-ray scattering, specular reflectivity measurements and by transmission electron microscopy (TEM). We have adopted the technique of grazing incidence diffraction (GID) to measure the diffuse scattering at small angles, close to the plane of incidence [1]. We demonstrate the advantages of this new technique as compared to off-specular measurements in the plane of incidence. Using x-rays from a synchrotron radiation source (ESRF) we combine triple crystal diffractometry and grazing incidence and exit angles to achieve large lateral momentum transfer together with high resolution. Due to the onedimensional periodic structure of the ML, the diffuse scattering intensity is found to be concentrated in "Bragg sheets" through the ML Bragg points.

The decay of the diffuse intensity as a function of lateral momentum transfer is used to determine the height-height self-correlation function. It is found to decay logarithmically (static exponent \( H=0 \)) for ML grown at low Ar pressure. From the broadening of the "Bragg sheets" along the momentum transfer in growth direction as a function of the lateral momentum transfer the number of interfaces, \( N \), which contribute coherently to the diffuse scattering on a given length scale is obtained. \( N \) can be related to the cross-correlation function and thus the dynamic exponent is determined (\( z=2 \) for low Ar pressure). The results are discussed in terms of theoretical predictions for various growth models. For low Ar pressure we find heightcorrelations (exponents \( H \) and \( z \)) expected from the Edwards-Wilkinson description of growth. For high Ar pressure the roughness morphology changes dramatically and can be described by the Huygens principle growth model [2]. The corresponding values for \( H \) and \( z \) compare well with our experimental results (\( H=0.7 \) and \( z=1.37 \)). The real structure of the ML is demonstrated by TEM pictures. They support the results from the diffuse scattering study.


The multilayer mirrors with 0.4°-0.5° reflection region and reflectivity of 4030% at CuK\( \alpha \) radiation are developed for various applications, including focusing and scanning of x-ray beams. This is accomplished by forming a structure with continuously decreasing period from the substrate to the surface. Several pairs of materials were tested: W-C, W-Al, Cu-C. A adequate mathematical simulation was developed, taking into account the divergence of the beam, the roughness and real optical constants of the layers, that enabled to determine optimal structure parameters. The multilayer coating was formed with magnetron sputtering installation, calibrated thoroughly according to special procedure, providing the accuracy within 1-2Å of layers thickness. As a result a good agreement was achieved between experimental and theoretical results (fig. 1). The substrate and interfaces roughness were investigated with AFM and HREM methods (fig.2).

![Fig.1. The reflection curve of a W-Al multilayer mirror with 20 bilayers](image1)

![Fig.2. The HREM image of the W-Al multilayer structure](image2)