Kossel X-ray standing-waves within a Cr/B_4C/Sc multilayer excited by protons

K. Le Guen[1], M.-Y. Wu[1], J.-M. André[1] V. Ilakovac[1,2], I. Vickridge[3], D. Schmaus[3], C. Burcklen[4], S. de Rossi[4], F. Delmotte[4], F. Bridou[4] and P. Jonnard[1]

[1]*Sorbonne Universités, UPMC Univ Paris 06, CNRS UMR 7614, Laboratoire de Chimie Physique - Matière et Rayonnement, 11 rue Pierre et Marie Curie, F-75231 Paris cedex 05, France*
[2]*Université Cergy Pontoise, F-95031 Cergy Pontoise, France*
[3] *Sorbonne Universités, UPMC Univ Paris 06, CNRS UMR 7588, Institut des NanoSciences de Paris, 4 place Jussieu, boîte courrier 840, F-75252 PARIS cedex 05, France*
[4]*Laboratoire Charles Fabry, Institut d'Optique Graduate School, CNRS, Université Paris-Saclay, F-91127 Palaiseau Cedex, France*

A characteristic X-ray line emitted from an atom within a periodic structure can be diffracted by the (emitting) structure itself according to the Bragg law. The subsequent Kossel [1] interferences lead to a modulation of the x-ray line intensity as a function of the detection angle in the vicinity of the Bragg angle value [2]. Standing-wave mechanism and Kossel diffraction can be viewed as space reversed processes by virtue of the reciprocity theorem. Kossel interferences have been yet observed using incident X-ray radiation [3-4], electrons [1-2, 5] and ions [6], in crystals [2,5-6] and in periodic multilayers [2-4].

In the present work, we have studied the characteristic Cr and Sc Kα emissions produced by a periodic Cr/B_4C/S multilayer exposed to a beam of 2 MeV-protons. The period of the multilayer is close to 2 nm. The intensity of these two emission lines is measured as function of the grazing exit angle, *i.e.* the angle between the direction of the detector and that of the surface of the multilayer. In the case of the Sc Kα emission, in Figure 1 we compare the experimental results to those calculated combining a classical recursive approach to the reciprocity theorem. To our knowledge, it is the first time that ions are used to induce Kossel diffraction in a multilayer. Refined details about the structure of the stack could be obtained, especially the profile and nature of the interfaces.

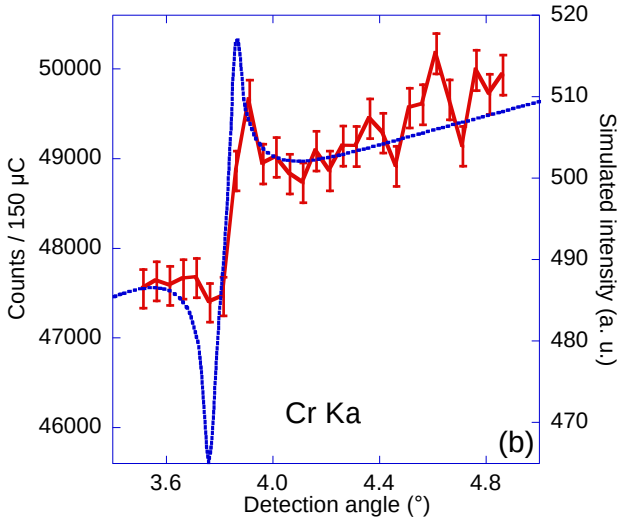

Figure 1: Measured (red) and calculated (blue) intensity of the Sc Kα emission as a function of the detection angle.

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