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MC X-Ray, The Monte Carlo Program for Quantitative Electron Microscopy of Real Materials

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MC X-Ray [1] is a new Monte Carlo program that allows quantitative electron microscopy of real materials. This program is an extension of the Monte Carlo programs Casino [2] and Win X-Ray [3] since it computes the complete x-ray spectra from the simulation of electron scattering in solids of various types of geometries. This new program, which has been completely reprogrammed in C++ under a window environment, is a real improvement because Win X-Ray is only able to compute x-ray spectra of homogeneous materials and CASINO performs only the computation of net x-ray intensities in a limited set of geometries. MC X-Ray allows more than 100 different regions in the materials having shape of spheres, cylinders and combinations of horizontal and vertical planes. All these regions can have a different composition.

As an example, simulated 128 X 128 images of a 20 nm thin foil of a 50 (wt.) % B - Fe alloy with a 20 nm square W phase (left) and a 20 nm square Cr phase (right) at 200 keV with 50 e per pixels were performed. Figure [1] shows the B $K\alpha$ generated intensity map. The length of the x scan was twice the length of the y scan and this explains the rectangular shape of the W and Cr phases. Figure [2] shows the B $K\alpha$ emitted intensity map and absorption effects are seen towards the x-ray detector located towards the top of the image with a 20° TOA. Figure [3] shows the Fe $K\alpha$ emitted intensity map and absorption effects are negligible because of its higher photon energy. Figure [4] shows a dark field image. Bright field images can also be simulated as well as High Annular Dark Field Images with a choice of collection angles from the user.

Details to obtain Mc X-Ray are given at http://montecarlomodeling.mcgill.ca/.

References:

1.P. Michaud and R. Gauvin (2009), “MC X-Ray, a New Monte Carlo Program for Quantitative X-Ray Microanalysis of Real Materials”, Microscopy and Microanalysis, 15 (Supp.2), p. 488-489.

2.P. Hovington, D. Drouin and R. Gauvin (1997), “Casino: A New Era of Monte Carlo Code in C Language for Electron Beam Interaction, Part I: Description of the Program”, Scanning, Vol.19, pp. 1-14.

3.R. Gauvin, E. Lifshin, H. Demers, P. Horny and H. Campbell (2006), “Win X-ray, a new Monte Carlo Program that Computes X-ray Spectrum for X-ray Microanalysis in the Scanning Electron Microscope”, Microscopy & Microanalysis, 12, pp. 49 - 64.

Figure [1] B K_α generated intensity map.

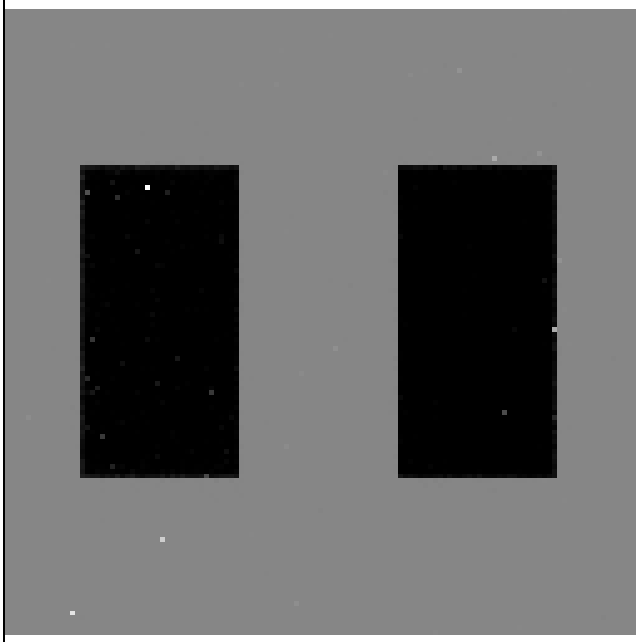


Figure [2] B K_α emitted intensity map.

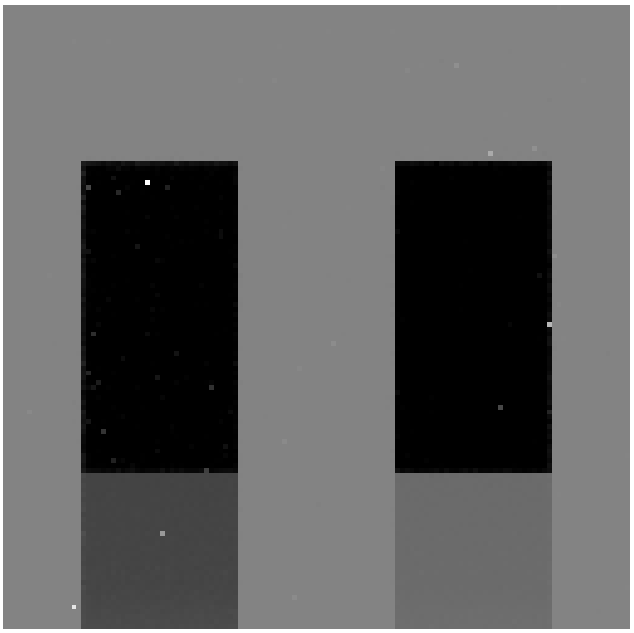
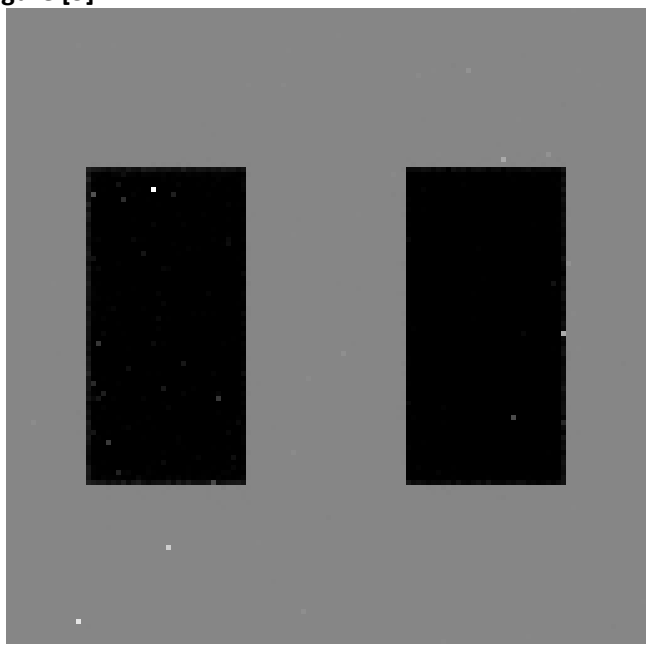
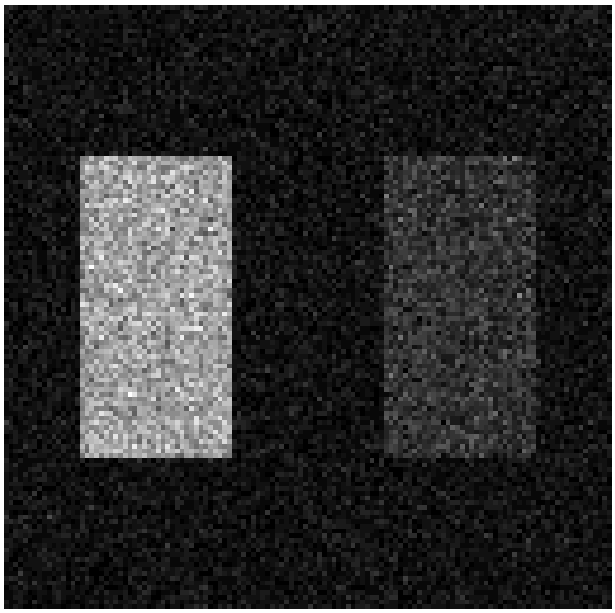


Figure [3]



Fe K_α emitted intensity map.

Figure [4]



Dark Field image.

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