Numerical Simulation of MLLs with Layer Displacement Error

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The influences of the displacement error of each layers in tilted Multilayer Laue Lens(MLLs) is simulated by Beam Propagation method(BPM)[1].We investigate the convergence of BPM in our cases , then compare the wave field distributions in the output plane and focal plane with the results calculated by Takagi-Taupin description(TTD) of dynamical diffraction theory[2] . The two methods coincidence very well. After adding the layer displacement error in the MLLs , the input wave field is propagated through MLLs and to the focal plane. The FWHM and focusing efficiency of the focal spot is presented.

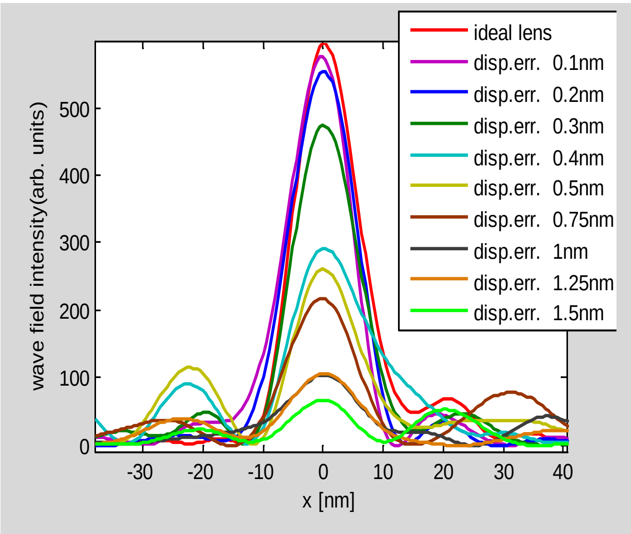

Fig. 1. Wave field intensity distribution in the focal plane. The main parameters of the tilted MLL are: E=19.5kev，Si/WSi2, x_{max}=30um,f=4.72mm,tilt_angle=1.6mrad

A sequence of displacement error is added to layers in the MLLs. After getting the wave field distribution in the output plane of the focusing lens, We employ Fresnel-Kirchhoff integral[3]to calculate the intensity distribution near the focal plane. As expected, the displacement error of layers leads to the decrease of focusing efficiency and a broadening of the focal spot. As the displacement error can be measured by scanning electron microscope(SEM), We plan to use this simulation method to calculate the wave field distribution behind a real tilted MLL with imperfections.

[1]Thylén. L, Optical and Quantum Electronics ,15(5) (1983).
[2] H. F. Yan, J. Maser, A. Macrander, Q. Shen, S. Vogt, G. B. Stephenson, and H. C. Kang, Phys. Rev. B **76**, 115438 (2007).
[3] M. Born and E. Wolf, *Principles of Optics*, 7th ed. (Cambridge University Press, Cambridge, 1999).