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Characterization of x-ray spatial coherence and its propagation

Binhua Lin
The Center for Advanced Radiation Sources, The Universty of Chicago, 5640 S. Ellis Ave., Chicago, IL 60637

M. L. Schlossman
Department of Physics and Department of Chemistry, The University of Illinois (M/C 273), Chicago, 60607

M. Meron
The Center for Advanced Radiation Sources , The Universty of Chicago, 5640 S. Ellis Ave., Chicago, IL 60637

S. M. Williams
Department of Physics and Department of Chemistry, The University of Illinois (M/C 273), Chicago, 60607

P. J. Viccaro
The Center for Advanced Radiation Sources and The James Franck Institute, The University of Chicago, Chicago 60637

X-ray beams of varying degrees of partial spatial coherence have been prepared and characterized and the diffraction of these beams from patterned surfaces measured. The experiments were carried out at a bending magnet source at the NSLS (X-19C). Here, the resulting diffraction patterns for optical gratings are analyzed in terms of an x-ray mutual coherence function, used to describe the propagation of the coherent wavefront in the visible light regime. The diffraction and speckle pattern from the surface are the result of the mutual coherence function convoluted with the interference function of the grating. We show that the speckle patterns formed from partially coherent wavefronts contain relevant information concerning the interference function characterizing the grating surface. Forming diffraction patterns, or x-ray speckles, with partially coherent x-rays as a probe of the surface relaxes the requirement for the interference, therefore gaining in the "effective" coherent flux. In addition, detailed knowledge on the propagation of the spatial coherence of x-rays aids in defining the physical characteristics of optical elements in the beamline which must preserve the coherence wave front of x-rays.