Fourier Transform Techniques Using Coherent Hard X-rays

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The availability of microoptics such as Fresnel zone plates (FZP) and compound refractive lenses (CRL) at high X-ray energies along with highly brilliant synchrotron radiation sources has opened up new directions of the Fourier optics development in high resolution imaging and diffraction techniques. First example deals with Fourier transform holography, where FZPs optimized for hard x-rays are used to split the beam providing a submicron first- or third-order diffraction reference wave and zero order diffraction beam for sample illumination. As for second example, the Fourier transforming and imaging properties of X-ray refractive lenses will be discussed. It was already demonstrated that parabolic CRLs have no spherical aberrations and are excellently suited for imaging purposes with submicrometer resolution. The use of the parabolic CRL as a Fourier transformer allows to achieve a micro- and submicro-radian angular resolution. First results with test samples demonstrate very promising applications for small angle X-ray scattering and high-resolution single crystal diffraction experiments.