

论文

微聚焦X射线成像的相位效应分析

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摘要:

根据Fresnel-Kirchhoff衍射理论,结合临床实际,考虑振幅近似和相位缓变条件,由傅里叶变换和卷积定理,导出了微聚焦X射线相衬成像(X-ray Phase-contrast Imaging, X-PCI)在像平面上焦斑尺寸范围内的能量密度分布函数.结果显示,像密度函数是吸收效应滤波函数FA(x)和相位效应滤波函数FP(x)分别与吸收项A2(x)和相位项A2(x)φ(x)作卷积运算后的和.利用mathematica软件分析讨论了该函数的分布规律,并给出了理论解释.结果表明,吸收效应对像密度的影响在焦斑范围内保持不变|相位效应对像密度的影响在焦斑范围内逐渐加强|在焦斑一定范围内,相位效应的影响远大于吸收效应.

关键词: 微聚焦X射线相衬成像 吸收效应 相位效应

Analysis of the Absorption and the Phase-effect on Micro-focus X-PCI

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Abstract:

Based on Fresnel-Kirchhoff diffraction theory,taking the clinical conditions of the amplitude approximation and the moderate variation condition for phases into account,the image intensity formulas of micro-focus X-PCI in the range of focal aperture on the image plane are derived by Fourier transform and the convolution theorems.The results indicate that the image intensity formula actually is a sum of convolutions of the absorption-effect filter formulaFA(x) and the phase-effect filter formula FP(x) with the object attenuationA2(x)and attenuated phase A2(x)φ(x),respectively.After the analysis of the regularities of the formulas by mathematica ,the theoretical explanations of the regularities we given and the conclusions obtained are that: first,the effect of the absorption-effect on the image intensity remains constant in the range of focal aperture; second,the effect of the phase-effect on the image intensity gradually strengthens in the range of focal aperture; third,the effect of the phase-effect on the image intensity is much more than the one of the absorption-effect in a given rang of focal aperture.

Keywords: microfocus X-ray Phase-contrast imaging absorption-effect phase-effect.

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