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摘要: 利用对数螺线晶体在大视场范围内的保角特性, 研究了一种用于等离子体X射线单色成像的透射式对数螺线晶体分析器。与反射式弯晶成像谱仪相比, 该分析器具有单色成像视场更大, 实现相同放大倍数时的空间排布简单等优点。根据晶体衍射成像原理及对数螺线晶体的表面方程, 分析了透射式对数螺线晶体分析器的成像原理以及成像性能, 包括子午、弧矢放大倍数以及视场大小等。以铜靶X射线源为背光源, 用研制石英晶体透射对数螺线分析器对网丝直径为100 μm 的金属网格进行了单色背光成像实验。实验结果表明, 晶体分析器的空间分辨力约为30 μm , 子午和弧矢方向视场分别达到15.938 7 mm和5.900 6 mm。

关键词: 等离子体X射线 透射式晶体分析器 对数螺线 单色成像

Transmission type logarithmic spiral crystal analyzer for monochromatic X-ray imaging

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Abstract: On the basis of the conformal characteristics of a logarithmic spiral crystal in a large field of view (FOV), a new type of transmission crystal analyzer used for X-ray monochromatic imaging was investigated. Compared with a reflection type of crystal analyzer, the logarithmic spiral crystal analyzer has a wider FOV for catching the monochromatic X-ray image and a simple space arrangement for achieving the same magnification. According to the diffraction theory of the crystal and the surface equation of log spiral, the imaging principles and characteristics of the transmission type logarithmic spiral crystal analyzer were researched, including the magnifications in horizontal and vertical directions as well as the FOV sizes. A logarithmic spiral analyzer with a quartz crystal was developed. Then with the proposed analyzer, the monochromatic backlighting experiment for the mesh grid with a diameter of 100 μm was carried out by taking an X-ray source of Cu target as the backlighter. The experimental results show that the FOVs of the transmission type logarithmic spiral crystal analyzer are 15.938 7 mm and 5.900 6 mm in horizontal and vertical directions, respectively. Furthermore, the spatial resolution of the analyzer is at least 30 μm under a source diameter of 110 μm .

Keywords: plasma X-ray transmission type crystal analyzer logarithmic spiral monochromatic imaging

收稿日期 2012-05-11 修回日期 2012-06-18 网络版发布日期

基金项目:

国家自然科学基金委员会-中国工程物理研究院联合基金资助项目(No.10976033)

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