

论文

亚波长金属光栅的衍射辐射特性研究

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摘要:

分析了亚波长金属光栅的双边衍射辐射机制和特性. 利用运动电子激励亚波长光栅结构, 研究了其产生的双边衍射辐射. 通过三维粒子模拟软件仿真, 得到了光栅上下空间的电场空间分布, 结合结构辐射布里渊图, 证明了亚波长对称光栅上下半空间的衍射辐射场分布同样可以由Smith-Purcell辐射公式来解释, 即主要有电子运动速度和光栅周期决定, 并分别研究了缝隙宽度、光栅厚度对上下半空间衍射辐射的影响. 为进一步研究下半空间的衍射辐射场, 采用了非对称的光栅结构, 研究表明非对称光栅下半空间衍射辐射场不仅取决于电子运动速度和结构下表面的周期, 同时也与电子运动激励起的上半空间的辐射频率范围密切相关.

关键词: 亚波长 光栅 衍射辐射 非对称光栅 粒子模拟

Diffraction Radiation of Subwavelength Metallic Grating

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Abstract:

The mechanism and characters of diffraction radiation of subwavelength metallic grating structure are analysed and discussed. Using the three dimensional particle-in-cell simulation, the contour map of electric field of the grating is obtained excited by moving electron bunch. Combined with the Brillouin diagram, it shows that the diffraction radiation in the upper and lower half-space can also be explained by the formula of Smith-Purcell radiation. Then, the influences of the gap width and the thickness of the grating to the diffraction radiation are also analyzed. Based on the comparison for the asymmetric grating excited by different beam energies, the physical mechanism of the diffraction radiation in the lower half-space are discussed in further. For asymmetric grating, the diffraction radiation in the lower half-space are determined by the velocity of electron and the grating period, and by the radiation in the upper half-space.

Keywords: Subwavelength Grating Diffraction radiation Asymmetric grating Particle-in-cell simulation

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