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电子束引出窗冷却研究

何小海[1,2],林理彬[1],肖德鑫[2],李琦[2],刘平[2]

1. 四川大学 物理科学与技术学院，四川 成都 610064
2. 中国工程物理研究院 四川久环电气有限公司，四川 绵阳 621900

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摘要 研究1 MeV、40 mA工业辐照电子加速器引出窗钛膜受力状况，确定钛膜在大气作用下的几何形状，计算电子束在钛膜上各点的入射角度和相应的穿越深度，给出电子束在钛膜上的能量损失分布与钛膜强度、厚度、跨度之间的关系。分析钛膜自身热传导和热辐射的散热能力，表明强迫风冷是提高引出窗输出能力的重要冷却方式。结合数值模拟方法，重点研究强迫风冷的散热能力与出口风速、钛膜曲率半径之间的关系。发现常规风冷结构设计中可能出现回流区，成为窗膜的冷却盲点，需通过结构优化设计消除回流区的影响。

关键词 电子束 附壁射流 强迫风冷 热传导 热辐射

分类号

Cooling of Electron Beam Extraction Window

HE Xiao-hai[1,2], LIN Li-bin[1], XIAO De-xin[2], LI Qi[2], LIU Ping[2]

1. College of Physical Science and Technology, Sichuan University, Chengdu 610064, China;
2. China Academy of Engineering Physics, P. O. Box 919-826, Mianyang 621900, China

Abstract Through study on stress of titanium foil of extraction window, geometric shapes of titanium foil at atmospheric pressure were determined; thus incident angles of electron beam on titanium foil and the corresponding penetration distance were calculated, thereby the relationships between distributions of energy loss of electron beam on titanium foil and the yield strength of the titanium foil, the thickness as well as the span were obtained. Through analysis on heat dissipation capability of heat transfer and heat radiation of titanium foil itself, it's concluded that wind-cooling is the best way to increase the output capability of extraction window. Combined with numerical simulation, study on the relationships among heat dissipation capability of wind-cooling, air velocity and curvature radius of titanium foil is stressed, through which it's concluded that reflux zone may exist at conventional wind-cooling structure and turn out to be a weak spot for titanium foil cooling and the effect of reflux section needs to be removed by means of optimization of the structure.

Key words electron beam wall jet wind-cooling heat transfer heat radiation

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