上海光源光束线液氮单色器真空夹层抽气系统设计

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摘　要:针对上海光源部分光束线液氮单色器真空夹层真空度下降、液氮管路冷量损失引发夹层外壁冷凝滴水、结霜等威胁运行安全的问题,设计了具有真空度反馈控制和定时启动功能的自动抽气系统。模拟计算了夹层外壁不同真空度下的冷量损失及温度分布变化规律,确定了系统工作的真空度阈值等参数。设计的抽气系统当前在束线液氮单色器上运转良好,有助于束线稳定运行。

关 键 词:液氮单色器;运行安全;抽气系统设计

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Design of Automatic Pumping System for Liquid Nitrogen Cooling Monochromators of SSRF

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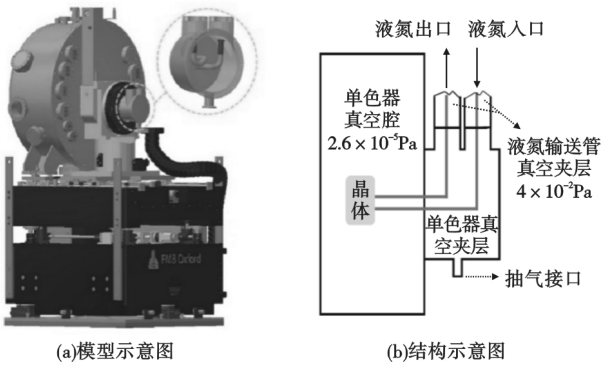
Abstract: In view of the problems of condensation and dripping water and frost on the outside of the interlayer caused by decreasing vacuum degree for the vacuum interlayer of some beamline liquid nitrogen cooling monochromators, and the loss of cooling capacity of the liquid nitrogen pipeline in the Shanghai Synchrotron Radiation Facility, which threaten the operation safety. An automatic pumping system with vacuum feedback and timing start function is designed. Simulation and calculation of the cooling loss under different vacuum degrees of the interlayer help to determine the vacuum degree threshold and other parameters for the system to start. The as-designed pumping system currently works well on beamline liquid nitrogen cooling monochromators, helping to stabilize the beamline operation.

Key words: liquid nitrogen cooling monochromator; operation safety; pumping system design

光束线中单色器是基于色散或光栅衍射原理从输入较宽波长范围的辐射光中选择性透射较窄波长范围辐射的光学谱仪设备[1-2]。较高入射光能量带来的热负载需要利用液氮对单色器中晶体进行冷却。当前,上海光源有多条液氮冷却单色器的光束线。管路液氮输送过程中,通常复合利用真空隔热、填充绝热材料等方式减少冷量损失[3-5]。液氮单色器也有类似的真空夹层,如图 1 所示。然而由于夹层内壁材料放气及泄漏等原因,夹层内真空度下降导致冷量损失增大[6-8]。因此,夹层外壁冷凝滴水及结霜等威胁运行及人身安全的情况时有发生,如图 2 所示。



(a)模型示意图　　(b)结构示意图

图 1　液氮单色器模型及结构示意图

Fig.1　Model(a) and structure(b) diagram of liquid nitrogen cooling monochromator and its vacuum interlayer

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