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Report of Grazing-incidence Focusing Small-Angle Neutron Scattering (gif-SANS) Spectrometer at CPHS

摘要

清华大学紧凑型脉冲强子源（CPHS）的掠入射聚焦小角中子谱仪（gif-SANS）解决了基于紧凑型加速器中子源建造高性能 SANS 仪器的挑战。该谱仪采用具有大收集面积的多层嵌套中子聚焦超镜，在 Qmin<0.007Å^{-1} 处实现了 >10^{5}n/s 的中子通量。此外，由多个孔径光阑组成的后准直系统与聚焦镜配合使用，以阻挡杂散中子并抑制漫散射噪声，从而显著提高分辨率。该谱仪可切换至针孔准直模式以实现更高的 Q 测量。gif-SANS 配备了两个探测器：一个用于常规 Q 范围测量的大面积 ^{3}He 管阵列探测器，以及一个用于将 Qmin 扩展至 10^{-3}Å^{-1} 的高分辨率中子敏感微通道板（nMCP）探测器。整个仪器已通过实验验证，并成功通过了最终验收测试。

关键词

小角中子散射；中子光学

Abstract

The grazing-incidence focusing Small Angle Neutron Spectrometer (gif-SANS) at Compact Pulsed Hadron Source (CPHS) of Tsinghua University addresses the challenge of building high-performance SANS instrument based on Compact Accelerator-driven Neutron Sources. A multi-layer nested neutron-focusing supermirror with a large collecting area is used to achieve > 10^{5} n/s neutron flux at Qmin < 0.007 Å^{-1} in gif-SANS. In addition, a post-collimation system consisting of multiple aperture blades is employed in conjunction with the focusing mirror to block stray neutrons and suppress diffuse scattering noise, thereby significantly improving the resolution. The spectrometer can be switched to a pinhole collimation mode for higher Q measurements. Two detectors are equipped on gif-SANS: a large-area He-3 LPSD detector for normal Q-range measurements, and a high-resolution neutron-sensitive microchannel plate (nMCP) detector to extend the Qmin down to 10^{-3} Å^{-1}. The entire instrument has been experimentally validated and has successfully passed the final acceptance tests.

Keywords

SANS; Neutron optics

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