

技术及应用

# 应力测量中子衍射谱仪聚焦单色器的模拟

郭立平<sup>1, 2</sup>, 李际周<sup>1</sup>, 孙凯<sup>1</sup>, 李峻宏<sup>1</sup>, 陈东风<sup>1</sup>

1. 中国原子能科学研究院 核物理研究所, 北京 102413

2. 武汉大学 物理科学与技术学院, 湖北 武汉 430072

收稿日期 2006-9-4 修回日期 2007-3-16 网络版发布日期: 2008-1-20

**摘要** 为提高样品处入射中子束强度, 满足高分辨和小体积标样测量的需要, 应用MCSTAS软件对中国先进研究堆上应力测量中子衍射谱仪的核心部件垂直聚焦单色器进行模拟和优化设计, 得到了单色器在不同起飞角下的最佳聚焦条件, 即所需的曲率半径和相邻单晶条之间的最佳倾角。在此条件下, 可获得相对于平板单色器6~7倍的强度增益, 样品处中子注量率达 $10^7 \text{ cm}^{-2} \cdot \text{s}^{-1}$ 以上。在使用聚焦单色器的情形下, 对标准的 $\alpha\text{-Fe}$ 多晶样品在无应变、拉应变和压应变下的(211)衍射峰进行了模拟。结果表明:该谱仪的分辨水平至少能测量 $500 \mu\epsilon$ 以上的应变, 且应变测量最高精度约为 $20 \mu\epsilon$ 。

**关键词** [聚焦单色器](#) [蒙特卡罗模拟](#) [中子衍射](#) [应力](#) [MCSTAS](#)

**分类号** [TL817.3](#); [O242.2](#)

## Simulation Study on Focused Monochromator of Neutron Diffractometer for Stress Measurement

GUO Li-ping<sup>1, 2</sup>, LI Ji-zhou<sup>1</sup>, SUN Kai<sup>1</sup>, LI Jun-hong<sup>1</sup>, CHEN Dong-feng<sup>1</sup>

1. Department of Nuclear Physics, China Institute of Atomic Energy, Beijing 102413, China; 2. Department of Physics, Wuhan University, Wuhan 430072, China

**Abstract** In order to improve the incident neutron fluence rate at the sample position to allow both high-resolution and small sampling volume measurements, simulation and optimization on the vertical focusing monochromator, a key component of the neutron diffractometer for strain measurement to be built at China Advanced Research Reactor(CARR) was carried out using the MCSTAS code. The optimal focusing conditions, i.e. curvature radii and the tilting angle of the neighbor crystal slabs for the (511), (311) and (711) reflections under the take-off angles of  $60^\circ$ ,  $90^\circ$  and  $120^\circ$ , were obtained. A neutron fluence rate of above  $10^7 \text{ cm}^{-2} \cdot \text{s}^{-1}$  at sample position, which means an intensity gain of about 6-7 relative to flat monochromator, can be achieved under these optimal conditions. To test the optimal design of the vertical focusing monochromator, (211) diffraction patterns of  $\alpha\text{-Fe}$  sample, with no strain, tensile strain and compressive strain, respectively, were simulated. The simulated full width at half maximum of the diffraction pattern and the correspondent peak shift induced by the strain are in good accordance with the results obtained from analytical calculations. It shows that the diffractometer is at least capable of measuring the strain of above  $500 \mu\epsilon$  and the highest precision of strain measurement is about  $20 \mu\epsilon$ .

**Key words** [focusing monochromator](#) [Monte-Carlo simulation](#) [neutron diffraction](#) [stress](#) [MCSTAS code](#)

DOI

### 扩展功能

#### 本文信息

▶ [Supporting info](#)

▶ [\[PDF全文\]\(146KB\)](#)

▶ [\[HTML全文\]\(0KB\)](#)

▶ [参考文献](#)

#### 服务与反馈

▶ [把本文推荐给朋友](#)

▶ [文章反馈](#)

▶ [浏览反馈信息](#)

#### 相关信息

▶ [本刊中包含“聚焦单色器”的相关文章](#)

▶ 本文作者相关文章

· [郭立平](#)

· [李际周](#)

· [孙凯](#)

· [李峻宏](#)

· [陈东风](#)

