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核技术应用

$LaFeO_3$纳米材料电四极超精细相互作用TDPAC测量

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摘要

用时间微分扰动角关联方法测量了LaFeO3纳米中的电四极超精细相互作用. 扰动角关联探针核14057La 14058Ce由139La(n,γ)140La反应产生, 实验只观察到一个La晶位的四极相互作用. 在室温下， 20和40 nm以及晶体LaFeO3的四极相互作用频率ω0分别为 687.4，698.3 和742.9 Mrad/s，频率分布宽度系数σ分别为 0.014, 0.009和0.001, 电场梯度不对称系数η=0. 实验数据表明, 电场梯度主轴与晶轴方向一致; 样品具有菱方结构, 晶体到纳米发生菱方向正交结构转变, 纳米尺度越小, 越趋于正交结构; 由于邻近核的扰动, 随纳米颗粒增大, 四极相互作用频率分布宽度系数σ变小, 晶体时最小.

The quadrupole interactions in the nano and crystalline LaFeO3 perovskites have been investigated by TDPAC. The TDPAC probing nuclei 14057La 14058Ce were produced through the nuclear reaction 139La(n.γ)140La at the CIAE heavy water experimental reactor. One electric quadrupole interaction was detected for each material, which is assigned to the La site. The quadrupole interaction frequencies of 687.4, 698.3 and 742.9 Mrad/s with a distribution coefficient of 0.014, 0.009 and 0.001 were observed at room temperature for the 20 and 40 nm nano LaFeO3 and crystalline LaFeO3, respectively. The fitting yielded the EFG asymmetry parameter η=0, which indicates that the principal axes of the EFG is aligned with the crystallographic axes. The experimental results show that the structure of crystalline LaFeO3 is rhombohedral, the changing of the structure towards the orthorhombic structure takes place from the crystalline LaFeO3 to the nano LaFeO3, and the smaller the nano grain size, the larger the change. The frequency distribution is caused by the perturbation of the neighboring atoms, and thus, the distribution coefficient increases with decreasing the nano grain size and the crystalline LaFeO3 arrives at its maximum.

关键词 时间微分扰动角关联 电四极相互作用 $LaFeO_3$纳米材料

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