

Spin density wave order with single spin-spinless-stripe in $\text{La}_3\text{Ni}_2\text{O}_7$ probed by ^{139}La -NQR

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Abstract

Remarkable high- T_c superconductivity (SC) with $T_c \sim 80\text{K}$ was reported for bilayered nickelate $\text{La}_3\text{Ni}_2\text{O}_7$ under high pressure. In the previous ^{139}La -NMR studies at ambient pressure, the emergence of density wave order was microscopically observed below $T^* \sim 150\text{K}$ for $\text{La}_3\text{Ni}_2\text{O}_{7-\delta}$ and $\sim 130\text{K}$ for trilayered $\text{La}_4\text{Ni}_3\text{O}_{10-\delta}$ through the measurements of the NMR spectra and the nuclear spin relaxation rate[1]. In order to reveal the spin and/or charge states in the density wave order phase, we have performed ^{139}La -nuclear quadrupole resonance (NQR) measurements on these compounds at ambient pressure[2]. There are two crystallographically-inequivalent La sites, the La(1) site between the NiO_2 planes and La(2) site at the out-of-plane blocking layers. The La(2)-NQR study in bilayered $\text{La}_3\text{Ni}_2\text{O}_7$ clearly distinguishes the La(2)a site of the ideal $\text{La}_3\text{Ni}_2\text{O}_7$ from the other La(2)b site close to the local defects. Below 150K, almost half of the intrinsic La(2)a sites are dominated by a finite internal field within the ab plane, while the other half is dominated by a zero internal field. The result is consistently explained by the spin-density wave (SDW) order with single spin-spinless-stripe, where the reduced Ni magnetic moments are parallel to the ab-plane. Even for the La(2)b site close to the defects, the result is explained within the same model by considering the inhomogeneous internal magnetic fields that are enhanced around the nearby defects. These results provide unambiguous microscopic evidence for the SDW order with single spin-spinless-stripe below 150 K in $\text{La}_3\text{Ni}_2\text{O}_7$ at ambient pressure[2]. Recently we also performed the NQR measurement on trilayered $\text{La}_4\text{Ni}_3\text{O}_{10}$ and detected the different type of the density wave order state at intrinsic La(2) sites [3]. These results will provide further insight into understanding the relationship with the high- T_c states at high pressure in these nickel oxides.

References

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Keywords: Nickelate, NMR, NQR, Spin density wave, high pressure