Spin-split electronic structure in antiferromagnet NdBi revealed by laser-based spin- and angle-resoled photoemission spectroscopy with a micrometer spatial resolution

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Rare-earth monopnictides RX (R: rare earth, X: N, P, As, Sb, and Bi) have received renewed interest due to the topological electronic structure [1,2] and unusual magnetic transitions [3,4]. Recently, surface states with unconventional band splitting have been reported in the antiferromagnet NdBi, prompting discussions on their topological origins associated with the multi-q magnetic structure [5,6]. However, the information on the spin of the electronic structure has been unexplored.This study aims to determine the spin texture of NdBi by using spin- and angle-resolved photoemission spectroscopy (SARPES) [7]. The state-of-the-art SARPES machine with a micro-focused 6-eV laser at HiSOR enables us to investigate the spin texture for each spatially mixed magnetic domain. It is revealed that spin polarization for hole and electron bands appearing in the antiferromagnetic state is the opposite: the hole and electron bands show negative and positive spin polarization. Moreover, the spin-resolved measurements of the in-plane spin component demonstrated spin polarizations exceeding ±50%, consistent with density functional theory. Our observations provide a crucial key to understanding the origin of unconventional spin splitting in the AFM state.

References

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