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### **Intrinsic spin-dependent thermal transport<sup>1</sup>**

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Spin caloritronic effect, such as spin Seebeck effect, has attracted a great deal of attention recently. In most cases such studies have been made on patterned ferromagnetic thin films on substrates. The mechanism of spin Seebeck effect has evolved from intrinsic difference in the spin chemical potentials to magnon-phonon interaction through the substrate. We use patterned ferromagnetic thin film to demonstrate the profound effect of a substrate on the spin-dependent thermal transport. With different sample patterns and on varying the direction of temperature gradient, both longitudinal and transverse thermal voltages exhibit asymmetric instead of symmetric spin dependence. This unexpected behavior is due to an out-of-plane temperature gradient imposed by the thermal conduction through the substrate and the mixture of the anomalous Nernst effects. Only with substrate-free samples have we determined the intrinsic spin-dependent thermal transport with characteristics and field sensitivity similar to those of anisotropic magnetoresistance effect.

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