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Asymmetric and Negative Differential Thermal Spin Effect at Magnetic Interfaces: Towards Spin Seebeck Diodes and Transistors[1] JIE REN, JIAN-XIN ZHU, Los Alamos National Laboratory — We study the nonequilibrium thermal-spin transport across metal-magnetic insulator interfaces. The transport is assisted by the exchange interaction between conduction electrons in the metal and localized spins in the magnetic insulator. We predict the rectification and negative differential spin Seebeck effect (SSE), that is, reversing the temperature bias is able to give asymmetric spin currents and increasing temperature bias could give an anomalously decreasing spin current. We resolve their microscopic mechanism as a consequence of the energy-dependent electronic DOS in the metal. The rectification of spin Peltier effect is also discussed. We then study the asymmetric and negative differential magnon tunneling driven by temperature bias. We show that the many-body magnon interaction that makes the magnonic spectrum temperature-dependent is the crucial factor for the emergence of rectification and negative differential SSEs in magnon tunneling junctions. We show that these asymmetric and negative differential SSEs are relevant for building magnon and spin Seebeck diodes and transistors, which could play important roles in controlling information and energy in functional devices.

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