Spin-diode effect in a quantum dot hybrid system

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We investigate the generation of spin currents through temperature gradients in a quantum dot-based hybrid system, focusing on the spin diode effect. This system, consisting of a quantum dot coupled to a magnetic insulator and a (non)magnetic metallic electrode, operates with each electrode maintained at a different temperature, creating a finite spin current. Notably, the system exhibits a unique thermal spin-diode effect, where spin current is allowed to pass in one direction of the temperature gradient while being completely suppressed in the opposite direction. We explore the mechanisms behind this asymmetric behavior, driven by the magnonic energy-dependent density of states and many-body magnon interactions. In addition to the spin diode effect, we examine the system's potential as a spin Seebeck engine, converting heat into spin current, and establish the conditions for its efficient operation. The performance of the system, both as a thermal spin-diode and a heat-to-spin current converter, is analyzed, demonstrating its promise for future thermoelectric applications.

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