Publication

A double quantum dot spin valve

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A most fundamental goal in spintronics is to electrically tune highly efficient spin injectors and detectors, preferably compatible with nanoscale electronics and superconducting elements. These functionalities can be obtained using semiconductor quantum dots, spin-polarized by a ferromagnetic split-gate, which we demonstrate in a double quantum dot spin valve with two weakly coupled quantum dots in series, with individual split gates magnetized in parallel or anti-parallel. In tunneling magnetoresistance experiments we find a strongly reduced spin valve conductance for the two anti-parallel configurations, with a single dot polarization of similar to 27%. This value can be significantly improved by a small external magnetic field and optimized gate voltages, which results in a continuously electrically tunable quantum dot spin polarization of +/- 80%. Such versatile quantum dot spin filters are compatible with superconducting electronic elements and suitable for single spin projection and correlation experiments, as well as initialization and read-out of spin qubits. Efficient spin injection and detection with a high degree of polarization are fundamental requirements for any potential device relying on the spin degree of freedom rather than electronic charge. Here, the authors use two weakly coupled semiconductor quantum dots as electrically tunable spin injector and detector to achieve extremely large spin polarization controllable by the ferromagnetic split-gates.
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