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Saturation of spin-polarized current in nanometer scale aluminum grains
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We describe measurements of spin-polarized tunnelling via discrete energy levels of single Aluminum grains. In high resistance samples ($\sim G\Omega$), spin-polarized current is carried only via the ground state and the low-lying excited states, leading to a saturation in spin polarized current with bias voltage. Both a qualitative argument based on relaxation rates, and a non-equilibrium transport model are developed and compared. In two samples, the spin-relaxation rate T_1^{-1} for some of the low-lying excited states is comparable to the electron tunnelling rate: $T_1^{-1} \approx 1.5 \cdot 10^6 s^{-1}$ and $10^7 s^{-1}$, meaning the spin of an electron confined in a metallic grain is highly stable. The ratio of T_1^{-1} to the electron-phonon relaxation rate is in quantitative agreement with the Elliot-Yafet scaling, an evidence that spin-relaxation in Al grains is driven by the spin-orbit interaction.

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