Novel blockade due to spin-filtering with spin-orbit interaction

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We present the experimental finding of current blockade in a quantum dot (QD), which effect originates from spin-filtering (spin dependent blocking of the transport) in the tunneling through a quantum point contact (QPC) with spin-orbit interaction (SOI). [1] Possible spin-filtering effect due to many body correlation and SOI has claimed for the observation of conductance quantization to half-conductance quantum ($G_q/2 \equiv e^2/h$). Our (In,Ga)As (In content 10%) QD consists of such a QPC on a $G_q/2$ quantized plateau and the other one with the conductance around G_q, and showed clear Coulomb oscillation in spite of nearly open dot condition.

A Coulomb valley with the Kondo effect was picked up for the clarification of the spin state in the dot through the I-V characteristics and the temperature dependence. And the second next valley with spin 1/2 but without the Kondo effect was used to see the effect of spin-filtering. The valley is bounded by ordinal Coulomb peaks, one of which disappears with the applicaion of a finite source-drain bias voltage $V_{\rm sd}$ while the other grows in height. The sign reversal of $V_{\rm sd}$ transposes the heights of the two peaks. Further increase in $|V_{\rm sd}|$ recovers the dual peak configuration. Every aspect of the above characteristics behavior is explained under the hypothesis of spin-filtering in the QPC at the plateau of $G_q/2$. From the peak height ratio, the lower bound of the filtering efficiency is known as above 80%.

[1] S.W. Kim et al., arXiv: 1102.4648.