Spin Device

Spin Transistor utilizing Rashba SO interaction

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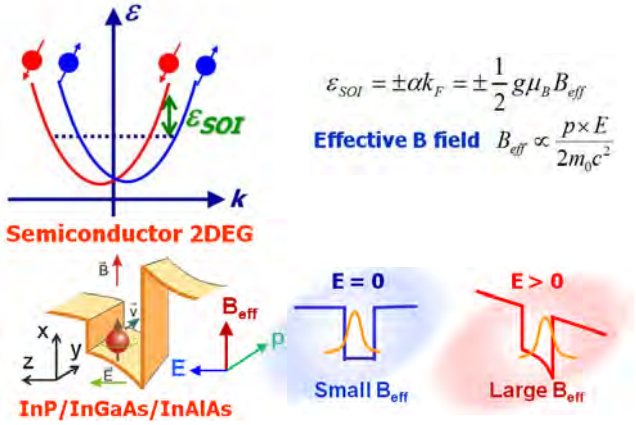
1. The newly proposed spin transisitor

・Spin-Orbit Interaction :

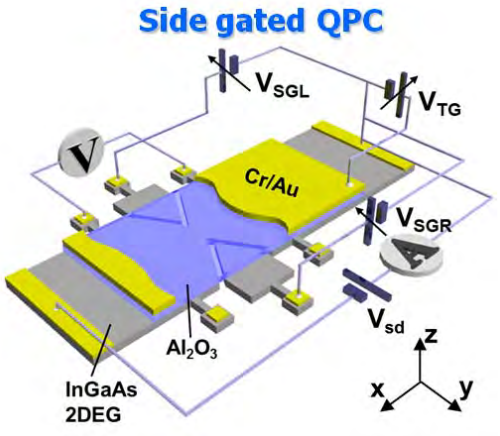
No need for external B fields (B_{ex}) and magnetic materials



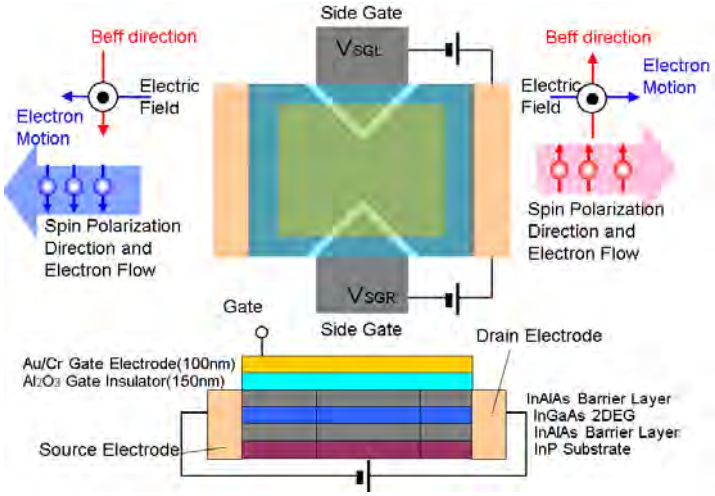
$$\varepsilon_{SOI} = \pm\alpha k_F = \pm\frac{1}{2} g\mu_B B_{eff}$$

Effective B field $B_{eff} \propto \frac{p \times E}{2m_0 c^2}$

・A proposed Device Structure

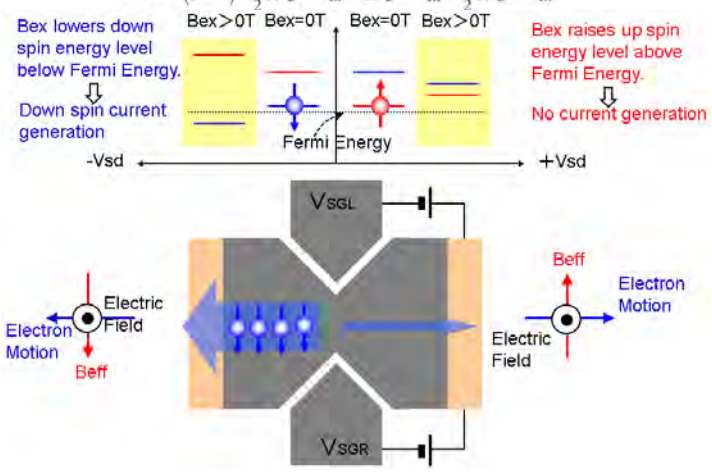


2. Mechanism to induce Spin Polarization and Spin Rectification Effect



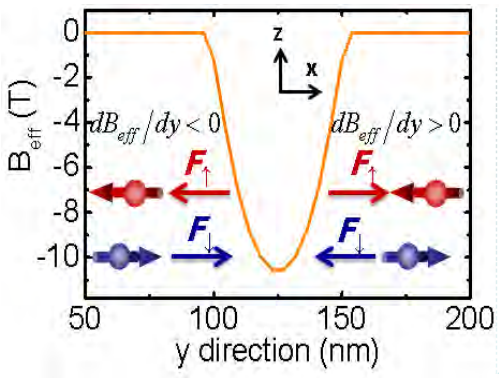
Spin Polarization Mechanism

$$H = \tilde{\alpha}\vec{\sigma}\cdot(\vec{p}\times\vec{E}) + \frac{1}{2}g\mu_B\vec{\sigma}\cdot\vec{B}_{ex} = g\mu_B\vec{\sigma}\cdot\vec{B}_{eff} + \frac{1}{2}g\mu_B\vec{\sigma}\cdot\vec{B}_{ex}$$

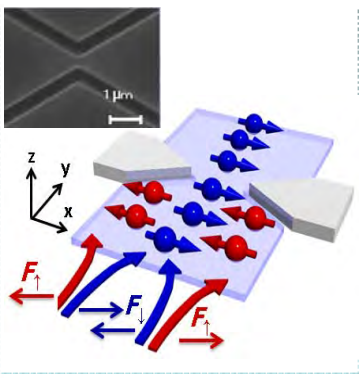


Spin Rectification Mechanism

3. Device Characteristics



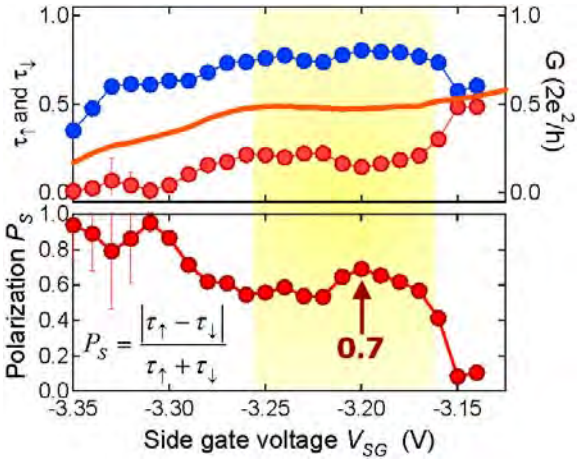
Calculated effective magnetic field B_{eff} along the y direction at x = 106 nm.



Spin Polarization induced by effective magnetic field B_{eff}

(The inset shows an image of a QPC channel region taken by a SEM.)

Maximum spin polarization is 70% at 0.5($2e^2/h$)



Spin Polarization at 0.5 ($2e^2/h$) structure

Patent Licensing Available

Patent No.: WO2013/027712(JP, US, EP, KR, CN)

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