

## Nonmagnetic Semiconductor Spin Devices

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We report concepts and modeling results on spin devices made from nonmagnetic semiconductor, and without the use of external magnetic fields or light sources. The devices exploit spin splitting induced by structural inversion asymmetry (SIA) and bulk inversion asymmetry (BIA). We will report on the following device concepts:

- (1) ***Bi-Directional Resonant Tunneling Spin Pump***. The spin pump takes advantage of the SIA spin configuration in asymmetric resonant tunnel structures to generate significant levels of spin current with very little net electrical current across the tunnel structure, a condition characterized by a greater-than-unity current spin polarization.
- (2) ***BIA Enhanced Resonant Tunneling Spin Filter***. We present a resonant tunneling spin filter containing a composite quantum well with optimized Rashba coefficients. We then show a simple method for enhancing spin filtering efficiency by properly combining the BIA and the SIA effects.
- (3) ***Resonant Spin Lifetime Transistors***. The consideration of the interaction of BIA and the SIA effects have led us to the concept of a variant of the Datta-Das transistor in which the switching action is accomplished by electrically controlling the spin lifetimes of electrons in the channel. The device can be the basis for a non-volatile memory.

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