INTRINSIC SPIN HALL EFFET AT ASYMMETRIC OXIDE INTERFACES: ROLE OF TRANSVERSE WAVE FUNCTIONS

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An asymmetric triangular potential well provides the simplest model for the confinement of mobile electrons at the interface between two insulating oxides, such as $LaAlO_3$ and $SrTiO_3$ (LAO/STO). These electrons have been recently shown to exhibit a large spin-orbit coupling of the Rashba type, i.e., linear in the in-plane momentum. In this paper we study the intrinsic spin Hall effect due to Rashba coupling in an asymmetric triangular potential well. This is the minimal model that captures the asymmetry of the spin-orbit coupling on opposite sides of the interface. Besides splitting each subband into two branches of opposite chirality, the spin-orbit interaction causes the transverse wave function (i.e., the wave function in the **z** direction, perpendicular to the plane of the quantum well) to depend on the in-plane wave vector **k**. At variance with the standard Rashba model, the triangular well supports a nonvanishing intrinsic spin Hall conductivity, which is proportional to the square of the spin-orbit coupling constant and, in the limit of low carrier density, depends only on the effective mass renormalization associated with the **k** dependence of the transverse wave functions. The origin of the effects lies in the nonvanishing matrix elements of the spin current between subbands corresponding to different states of quantized motion perpendicular to the plane of the well.

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