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Competiting interplay between Rashba and cubic-k Dresselhaus spin-orbit interaction in spin Hall effect[1] C.S. CHU, R.S. CHANG, Dept. of Electrophysics, National Chiao Tung University, Taiwan, ROC, A.G. MAL'SHUKOV, Institute of Spectroscopy, Russian Academy of Science, Russia —
We study the interplay between the Rashba and cubic-k Dresselhaus spin-orbit interactions (SOI) in a diffusive two-dimensional electron gas (2DEG). Within the spin Hall configuration, we perform a systematic calculation of the spin accumulation S_z and the spin polarizations S_i^B at the lateral edges and in the bulk of the 2DEG, respectively. Both the relative coupling strength of the Rashba and the Dresselhaus SOI, and the electron densities are varied. The spin accumulation exhibits strong competiting features, including in the Dresselhaus-dominant regime the sign change in S_z when electron density is large enough, and in the Rashba-dominant regime the complete suppression of S_z. Most surprisingly is our finding that the Rashba-dominant regime occurs as early as $\alpha \approx 2\tilde{\beta}$, where α, $\tilde{\beta}$ are the Rashba and the effective linear-k Dresselhaus SOI coupling constant, respectively. Similar Rashba-dominant regime is found in the spin polarizations, when $\alpha \geq \tilde{\beta}$. Our results point out that decreasing $|\alpha|$ leads to the restoration of the spin accumulation.

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Chon-Saar Chu
Dept. of Electrophysics, National Chiao Tung University, Taiwan, ROC

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