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Spin Gunn Effect YUNONG QI, Optical Science and Technology Center and Department of Physics and Astronomy, University of Iowa, Iowa City, IA 52242, ZHI-GANG YU, SRI international, 333 Ravenswood Avenue, Menlo Park, CA94025, MICHAEL E. FLATTÉ, Optical Science and Technology Center and Department of Physics and Astronomy, University of Iowa, Iowa City, IA 52242 — Even in nonmagnetic semiconductors the electron drift velocity depends on the electron spin polarization. This effect, originating from the Pauli excusion principle, drives a novel phenomenon we call the spin Gunn effect. We predict that the flow of unpolarized current in electron-doped GaAs and InP at room temperature is unstable at high electric fields to the dynamic formation of spin-polarized current pulses. Spin-polarized current is spontaneously generated because the conductivity of a spin-polarized electron gas differs from that of an unpolarized electron gas, even in the absence of spin-orbit interaction. Magnetic fields are not required for the generation of these spin-polarization current pulses, although they can help align the polarization of sequential pulses along the same axis. We also find that the spin polarization amplification rate is the largest for electron mobilities dominated by LO-phonon scattering, and that the steady-state (saturation) spin polarization can exceed 80% for both GaAs and InP at room temperature. Some possible applications to novel spintronics devices will also be suggested. This work was supported by DARPA/ARO, and more details are available in cond-mat/0407547.

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