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Design Guidelines for Spin-Polarized Lasers MICHAEL HOLUB, IGOR VURGAFTMAN, JERRY MEYER, BEREND JONKER, Naval Research Laboratory — Semiconductor lasers driven by a spin-polarized current are expected to provide a threshold current reduction and optical polarization control. The design of spin-polarized lasers is critical to the realization of these effects. Thus, we have investigated the effect of electron spin injection on semiconductor laser performance using a spin-dependent rate equation model.[1] The magnitude of the threshold reduction is shown to depend on intrinsic properties of the active region and laser cavity, and can approach a factor of 3.5 for fully spin-polarized electrons. The threshold reduction is found to be strongest in lasers with undoped active regions, recombination strongly dominated by Auger processes, and low threshold gain. Introduction of a ferromagnetic electrode in the vicinity of the active region for efficient spin injection generally results in higher internal loss and a requirement for greater material gain, which raises the laser's baseline threshold as well as lessens the projected threshold reduction. The placement of a ferromagnetic contact on spin-polarized laser performance will be discussed.

[1] I. Vurgaftman, M. Holub, B. T. Jonker, and J. R. Meyer *Appl. Phys. Lett.* **93**, 031102 (2008).

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