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High frequency dynamics and output polarization of a spin laser

PALLAB BHATTACHARYA, University of Michigan, Ann Arbor, DIPANKAR SAHA, Indian Institute of Technology Bombay, DEBASHISH BASU, University of Michigan, Ann Arbor — The dynamic characteristics of a spin laser have been studied theoretically and experimentally. Calculations with the coupled carrier and photon rate equations show that the small signal modulation bandwidth of the preferred polarization mode is enhanced due to spin injection. The large signal modulation characteristics show temporally separated relaxation oscillations corresponding to the two polarization modes. More importantly, it is shown that an output polarization of 100% can be obtained, with appropriate biasing conditions, irrespective of the degree of spin injection. This is experimentally verified in a quantum dot spin-vertical cavity surface emitting laser (spin VCSEL), where an output polarization of $\sim 60\%$ is measured with a 5-6% carrier spin polarization in the active region.

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