P09

Electrical spin injection from Ferromagnetic metal into GaAs in spin-LED structures

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Spin-LED structures were fabricated by depositing ferromagnetic metal (FM) layers of NiFe/CoFe on top of GaAs-based LED (light emitting diode) structures to study electrical spin injection from FM to a semiconductor. In order to improve the spin injection efficiency, thin tunneling barriers were incorporated between the FM layers and the semiconductors. The active layers consisted of either undoped or p-doped 30 nm GaAs layers. The samples were mounted in a superconducting magneto-optical cryostat and spin polarizations were measured from the circular polarization of the electroluminescence emitted from the LED surfaces. In the spectrum of the spin-LEDs, transition due to bound exciton was dominant at lower temperatures and at higher temperatures free excitonic transition became dominant. The circular polarization of the free excitonic transition at a temperature of 20 K was about 20 % at 3 Tesla, whereas that of the bound exciton was almost negligible. The circular polarization remained higher than 10 % up to 180 K, above which the electroluminescence was too weak to detect. Our results suggest that efficient spin injection using tunneling barriers from FM to semiconductors is possible even at high temperatures.