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Submicrometer Hall sensors for detection of magnetic nanoparticles in biomolecular sensing[1] GORAN MIHAJLOVIC, P. XIONG, S. VON MOLNAR, MARTECH and Dept. of Physics, Florida State Univ., K. OHTANI, H. OHNO, Research Inst. of Electrical Communication, Tohoku Univ., M. FIELD, G.J. SULLIVAN, Rockwell Scientific Company LLC — Significant progress has been made in the recent years in synthesis and biomolecular functionalization of magnetic nanoparticles. These magnetic bio-nanolabels can be utilized as protein or gene markers in biomolecular sensing assays, in contrast to the much larger micron sized magnetic beads that are usually limited to cell labeling. However, the low magnetic moments of individual nanoparticles (10^4-$10^5 \mu_B$) render their sensitive detection still a challenging task. In order to address this issue we are developing miniaturized Hall sensors from InAs/AlSb quantum well semiconductor heterostructures with active Hall cross areas down to 300 nm $\times$ 300 nm. Our preliminary characterization measurements performed at room temperature show functional devices with magnetic field resolution $< 100\ \mu\mathrm{T}/\sqrt{\mathrm{Hz}}$ at frequencies above 100 Hz, yielding a moment sensitivity $\sim 10^5\ \mu_B$. In addition to the progress in improving the moment sensitivity of the submicrometer Hall detectors, we will also present efforts in device integration with on-chip microcoils for the generation of local magnetic excitation fields. Results on nanoparticle detection will also be presented.

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