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Sub 100 nm ballistic sensors for ultra high spatial resolution magnetic field detection A.M. GILBERTSON, L.F. COHEN, Imperial College, M. FEARN, T. ASHLEY, QinetiQ, S.A. SOLIN, University of Washington in St. Louis, A. KORMÁNYOS, C.J. LAMBERT, Lancaster University — There is an ongoing drive to develop non-invasive magnetic field sensors with ultra high spatial resolution (UHSR) of 100 nm or less for numerous applications.[1,2] Conventional field sensors e.g. based on the Hall effect, rely on diffusive transport, where high mobility III-V semiconductors offer the best field sensitivity ($T/Hz^{0.5}$).[2] For UHSR, the critical dimensions of the device must be reduced below the mean free path where transport is ballistic, and the detection properties are not preserved, e.g. the Hall response can be suppressed and/or nonlinear. We report sub 100 nm sensors utilizing the negative bend resistance of InSb/InAlSb ballistic structures at elevated temperatures.[3] These devices exhibit an enhanced responsivity that is tunable by geometric design and extremely attractive for the detection of ultra small magnetic fields. Our smallest device studied to date has an active sensor area of 35 x 35 nm^2, and a sensitivity of 0.87 $\mu T/Hz^{0.5}$ at 100 K. The performance and detection properties are reviewed with respect to state-of-the-art technologies.
[1]P. Manandhar, Nanotechnol. 20, 355501 (2009). [2]A. Sandhu, Microelectron. Eng. 73, 524 (2004). [3]A. M. Gilbertson, et al., Submitted to Appl. Phys. Letts. (2010).

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