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Detecting Biomolecular Interactions with Semiconductor Hall Sensors[1]

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Semiconductor Hall magnetometry is a magnetic measurement technique with ultrahigh magnetic moment sensitivity and broad temperature and magnetic field operation ranges. These attributes make such devices, especially those based on high-mobility semiconductor heterostructures, ideal candidates as sensors for detecting biomolecular interactions using superparamagnetic labels. Magnetic moment sensitivity better than $10^4\mu_B/\mathrm{Hz}^{1/2}$ is demonstrated at low-temperature on GaAs/AlGaAs devices,[2] while room-temperature detection of a *single* superparamagnetic bead is realized with micro-Hall sensors based on InAs quantum wells.[3] The implementation of magnetic detection of protein binding[4] and DNA hybridization with InAs micro-Hall devices will be presented in this talk. Details of the sensing scheme, including fabrication and passivation of the devices, selective biomolecular functionalization of the Hall crosses, measurements of the Hall signals in response to specific biomolecular binding, and verification of the specificity of the Hall sensing via extensive fluorescence microscopy, will be described. The results demonstrate significant potential of the semiconductor Hall sensors for high-speed biomolecular sensing.

[1]Work done in collaboration with K.-S. Chen, K. Aledealat, P. Manandhar, G. Mihajlovic, S. Hira, G.F. Strouse, P.B. Chase, S. von Molnar, M. Field, G.J. Sullivan, and supported by NSF NIRT ECS-0210332 and NIH NIGMS GM079592.

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