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Design and Construction of a Super-Resolution Ground State Depletion Microscope to Optically Isolate GaAs Donors SARAH HARVEY, KAI-MEI FU[1], TODD KARIN, Univ of Washington — The ability to optically isolate single gallium arsenide electron donors has many implications both in quantum information science as well as semiconductor physics. However, conventional methods of fluorescence microscopy are fundamentally limited by diffraction, which sets a minimum resolvable feature size preventing the direct optical imaging of nanoscale structures. At the University of Washington Optical Spintronics and Sensing laboratory we are building a super-resolution optical microscope, based on ground state depletion, to isolate single GaAs donors. A critical component of the microscope is the raster scanning of laser beams over the sample, for which we have elected to use a piezoelectric fast-steering mirror. I have designed a scanning system capable of under 1 nm mechanical resolution, which will be sufficient for our target optical resolution of about 100 nm to isolate single donors. I will present preliminary results on the performance of the test system using a transmission electron microscopy (TEM) grid as a test sample, which will allow us to evaluate the achieved accuracy and resolution of the imaging due to its regular features. Isolating single donors in GaAs using this super-resolution microscopy technique may lead to new insights in how to localize and evaluate impurities such as donors and acceptors for quantum information as well as classical applications.

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