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Designing New Metal-Semiconductor Hybrid Structures With Large Geometric Magnetoresistance[1] LISA PUGSLEY, L.R. RAM-MOHAN, Worcester Polytechnic Institute, S.A. SOLIN, Washington University, St. Louis —
The extraordinary magnetoresistance (EMR) in metal-semiconductor hybrid structures was first demonstrated using a four-contact configuration for a circular semiconductor wafer with a concentric metallic inclusion in it. The EMR effect, which is observed at room temperature, is very suitable for use in read heads in magnetic data storage devices. This effect depends on the orbital motion of carriers in an external magnetic field, and the remarkably high magnetoresistance response (the change in resistance with a magnetic field) observed suggests that the geometry of the metallic inclusion can be optimized to significantly enhance the EMR. The theory and simulations to achieve this goal are considered by comparing various 2D structures in an external magnetic field to evaluate the EMR in them using finite element analysis and geometric optimization. For a 10 μm square semiconductor wafer with a square metallic inclusion we see a range in resistance from -400 to 400 Ω for -1 T $\leq B \leq$ 1 T. This response can be optimized by changes in contact orientation and the size and shape of the metallic region. Extension to 3D is being investigated at present, which would allow for modeling of magnetic field sensors that also provide the direction of the field.

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