

The Department of Mechanical Engineering presents:

The Ph.D. Dissertation Defense of **Paul Lou**

**Tuesday, December 4, 2018,
10AM in Bourns Hall A265**

Enhanced spin-orbit coupling in silicon

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Dr. Sandeep Kumar, Chairperson

The role of silicon in spintronic applications is often neglected due to the weak spin-orbit interactions from centrosymmetric crystal structure. In the study of Ni₈₀Fe₂₀/MgO/p-Si structure, we created Rashba-Dresselhaus spin-orbit coupling in silicon with strain and interfacial engineering. The induced strain gradient through thermal expansion compressive stresses and piezoresistivity broke the structural inversion symmetry, which induced flexoelectricity and charge separation. This led to cubic Rashba-Dresselhaus spin-orbit coupling throughout silicon and the interface that lifted the spin degeneracy in band structures and introduced intrinsic spin-Hall effect in n-type and p-type silicon. We confirmed the significant spin-Hall effect through spin-Hall magnetoresistance measurements. Further experiments revealed spin-mediated transport effects such as emergent antiferromagnetism and dissipationless spin current. This work substantiates the feasibility of silicon-based spintronics.