

Hydrodynamic Spintronics and Current Vortex

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In metals with disorder, the electron transport is described as diffusive. On the other hand, in those with electron-electron interaction being the dominant source of scattering, the motion of the electrons resembles the flow of classical liquids with shear viscosity, namely, the hydrodynamic fluids. The recent progress of nano-technology has made it possible to extend the study on such hydrodynamic electron fluids in nano-devices and low dimensional materials. In such fluids, the angular momentum of the fluid vorticity, i.e., current vortex, and electron spins couple each other due to the angular momentum conservation, i.e., the spin-vorticity coupling [1]. Combining the Navier-Stokes and the spin diffusion equations in the presence of the spin-vorticity coupling, we examine a variety of spintronic phenomena [2-4].

We present that metals with nano-structure provide unique spintronic devices due to the local hydrodynamic nature. The hydrodynamic phenomena of electron fluids open a door to "Hydrodynamic spintronics" .

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