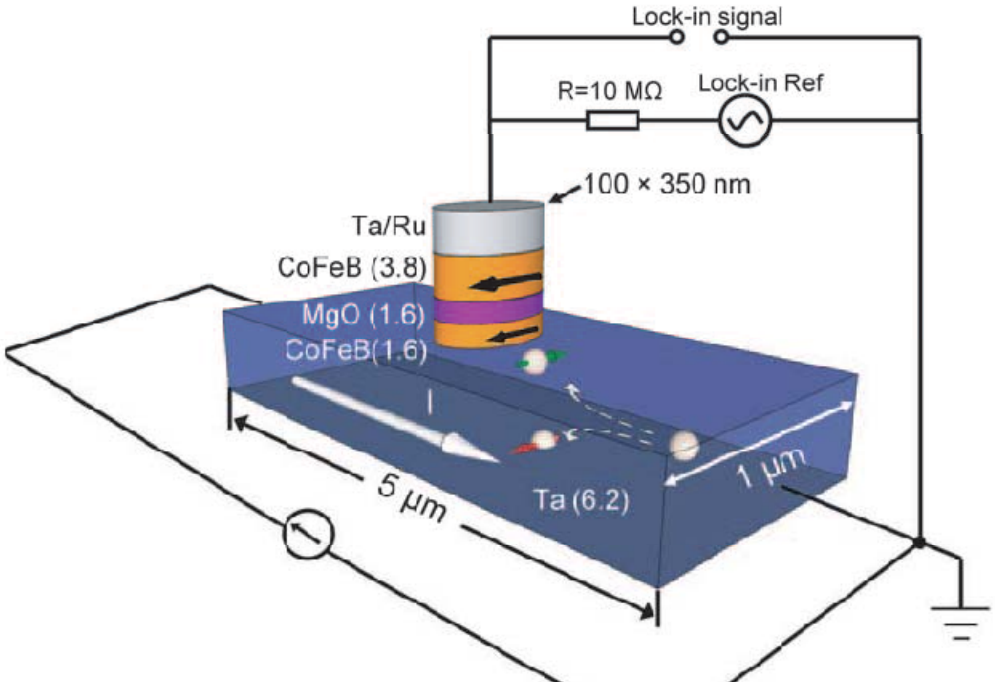
Spin-Torque Switching with the Giant Spin Hall Effect of Tantalum

The spin Hall effect is a phenomenon that occurs in metals with large atomic weights, in which electrons with different spins are deflected in different sideways directions, and consequently an applied charge current generates a flow of spin angular momentum transverse to the charge flow. The Buhrman and Ralph groups at Cornell used devices made at the Cornell NanoScale Facility to discover that the spin Hall effect in the high-resistivity form of tantalum is twice as strong as in any other material that has been investigated. They then implemented a new type of nonvolatile magnetic memory device that employs the spin current produced by passing a current through a tantalum layer to switch an adjacent nanomagnet, with a magnetic tunnel junction for read-out. This simple design is more reliable and efficient than competing technologies and eliminates the obstacles that have slowed the development of magnetic memory and nonvolatile spin logic technologies.



A 3-terminal magnetic memory device in which a lateral current flowing in a Ta layer switches the magnetic orientation of the lower magnetic layer in a magnetic tunnel junction by the spin Hall effect.

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Work performed at Cornell NanoScale Facility

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