# Building a Magnetic Scanning Probe Microscope Tip

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Spintronics and manipulation of spin is currently a hot research topic in science and engineering. Spin is a quantum phenomenon roughly akin to a child's spin top toy which can spin in the clockwise or counter clockwise direction. Electrons have spin up or down in relation to a magnetic field. In conventional electronics, information is carried by current, which is the flow of charge; information can also be transferred using spin current. Spin current uses the orientation of the electron spin to store information. Advantages of spintronics technology, in comparison to conventional electronics, would be to greatly reduce heat in devices, decrease electric power consumption, and increase data processing speed.

We are developing a procedure to construct a magnetic tip of samarium-cobalt. The challenge comes in placing a magnetic particle on a cantilever since the cantilever is about the thickness of one human hair. The ultimate goal is to study and manipulate spin with the aid of this magnetic tip. The magnetic tip applies a localized magnetic field to a nanowire constructed of indium arsenide and indium phosphide. Quantum wells located on the nanowire contain electrons with a spin of either up or down; it is this spin that we wish to manipulate using the magnetic tip. To construction the magnetic tip we use a glass probe (Fig.1) to glue a magnetic particle onto an atomic force microscope (AFM) cantilever (Fig.2). Next, we place the glued magnetic particle in a magnetic field to get either the south or north pole of the magnet pointing up before the glue dries. Using a scanning electron microscope (SEM), we can magnify our tips and see which are good candidates for milling with the focused ion beam (FIB) (Fig. 3). The magnetic particle is exposed to the FIB and milled in such a way that the final result yields a magnetic tip with a diameter of about 100nm. Now that's sharp!

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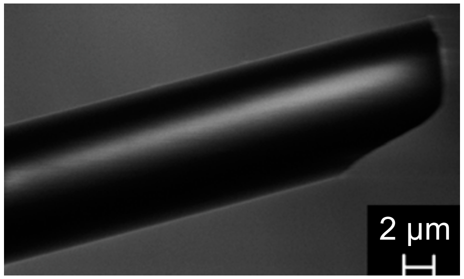


**Figure 1**. A glass probe with a tip diameter of about 8 microns.

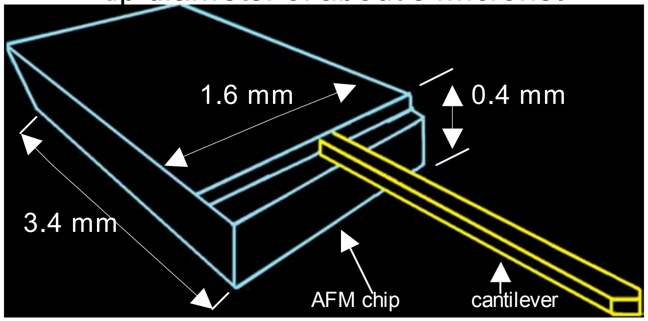


**Figure 2.** AFM chip with cantilever.

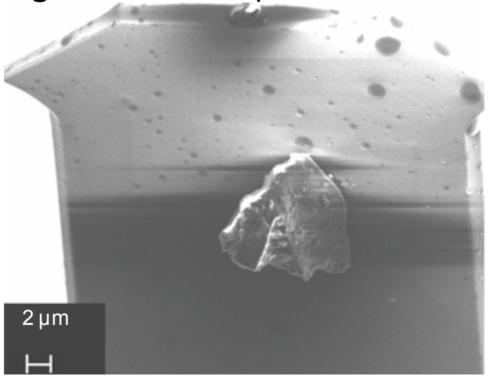


**Figure 3.** A cantilever of 30 microns width and a magnetic particle about 10 microns high.