



## Fabrication of Magnetic Tunnel Junctions with Epitaxial Ferromagnetic Layers

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**WARF: P05049US**

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**The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a new fabrication method that allows both the top and bottom FM layers to grow into strong texture or epitaxial structures on a variety of substrates, including silicon.**

### Overview

Tunneling magneto-resistive (TMR) read heads are the next generation in magneto-resistive readers for hard drive disks. TMRs typically include a magnetic tunnel junction (MTJ) that is composed of an oxidized, insulating layer, known as the tunnel barrier layer, sandwiched between two ferromagnetic (FM) layers.

The performance of the MTJ is highly dependent on the quality of the microstructures of the FM and tunnel barrier layers. Conventionally, a thin tunnel barrier metal is deposited on an FM layer; the tunnel barrier metal is oxidized; and then a top FM layer is deposited. However, this process forms a poly-crystalline top FM layer. Ideally, both top and bottom FM layers would be strong texture or epitaxial structures; however, all reported MTJs with epitaxial FM layers have limited industrial applications because they were grown on substrates other than silicon.

### The Invention

UW-Madison researchers have developed a new fabrication method that allows both the top and bottom FM layers to grow into strong texture or epitaxial structures on a variety of substrates, including silicon. In this method, a two to three nanometer top FM layer is deposited before, rather than after, the oxidation of the tunnel barrier metal. All three layers are strong texture or epitaxial structures. Next, the stack is exposed to a gas mixture to selectively oxidize the tunnel barrier metal. Finally, more FM and capping layers are epitaxially grown on the stack to produce a high quality MTJ.

### Applications

- Magnetic sensor and storage devices, including tunneling magneto-resistive (TMR) read heads and magnetic random access memory (MRAM)

### Key Benefits

- Creates magnetic tunnel junctions well suited for use in a variety of magnetic sensor and storage devices
- Avoids formation of the poly-crystalline top FM layer seen in other methods for fabricating magnetic tunnel junctions
- Works for most common FM materials, including NiFe, CoFe and Co, as well as most tunnel barrier materials, including Al, Y and Hf

### Additional Information

#### Related Technologies

- [See WARF reference number P04250US for a method of selectively oxidizing only the tunnel barrier layer in magnetic tunnel junctions.](#)

**Tech Fields**

- [Semiconductors & Integrated Circuits : Design & fabrication](#)

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