



MRAM

(Conventional to STT)

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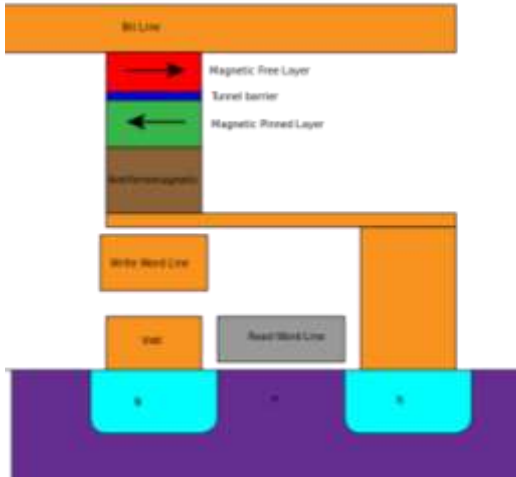
Kang Han Sol

- 1. Conventional MRAM**
 - Introduction
 - Principles
 - Limitation

- 2. STT MRAM**
 - Principles
 - Features

1. Conventional MRAM-Introduction

Feature of MRAM



- Non volatile memory
- limits cell sizes to around 180nm
- Write process requires more power consumption than DRAM
- indefinitely long lifetime
- Faster operation speed, lower power consumption than Flash memory

Comparison with other types of memory devices

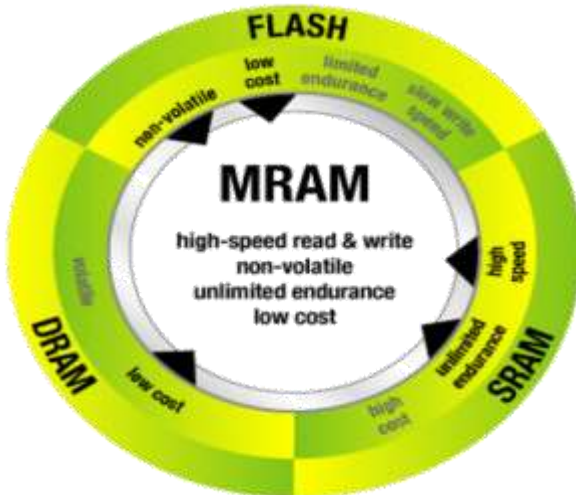


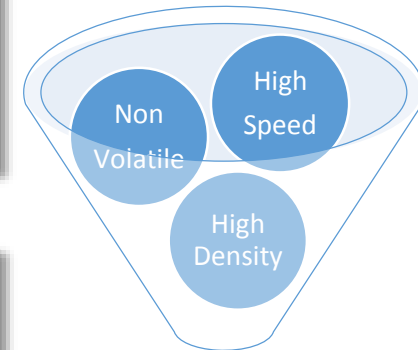
Table 1: Comparison of MRAM Expected Features with Other Memory Technologies

	SRAM	DRAM	FLASH	FRAM	MRAM
Read	Fast	Moderate	Fast	Moderate	Moderate-fast
Write	Fast	Moderate	Slow	Moderate	Moderate-fast
Nonvolatile	No	No	Yes	Partially ^b	Yes
Endurance	Unlimited	Unlimited	Limited ^c	Limited ^b	Unlimited
Refresh	No	Yes	No	No	No
Cell size	Large	Small	Small	Medium	Small
Low voltage	Yes	Limited	No	Limited	Yes

^aBold letters indicate undesirable attributes.

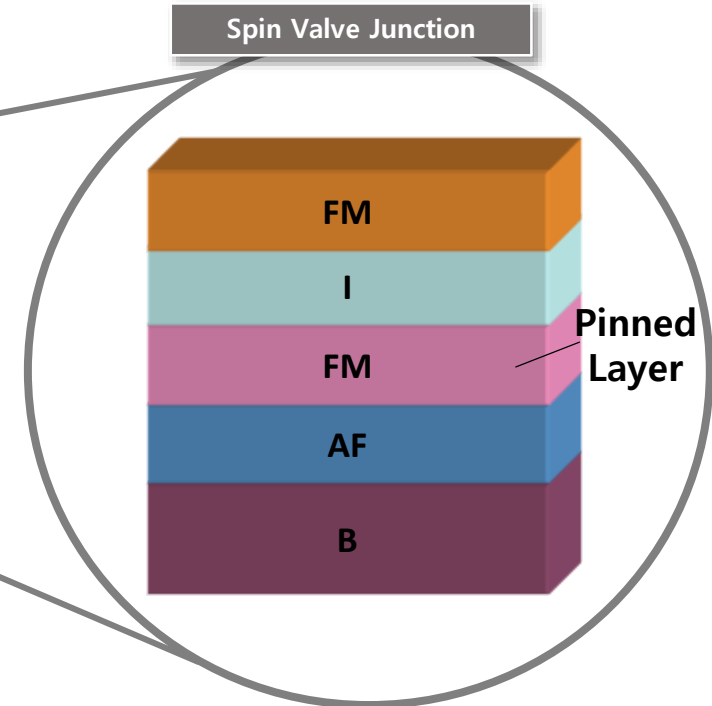
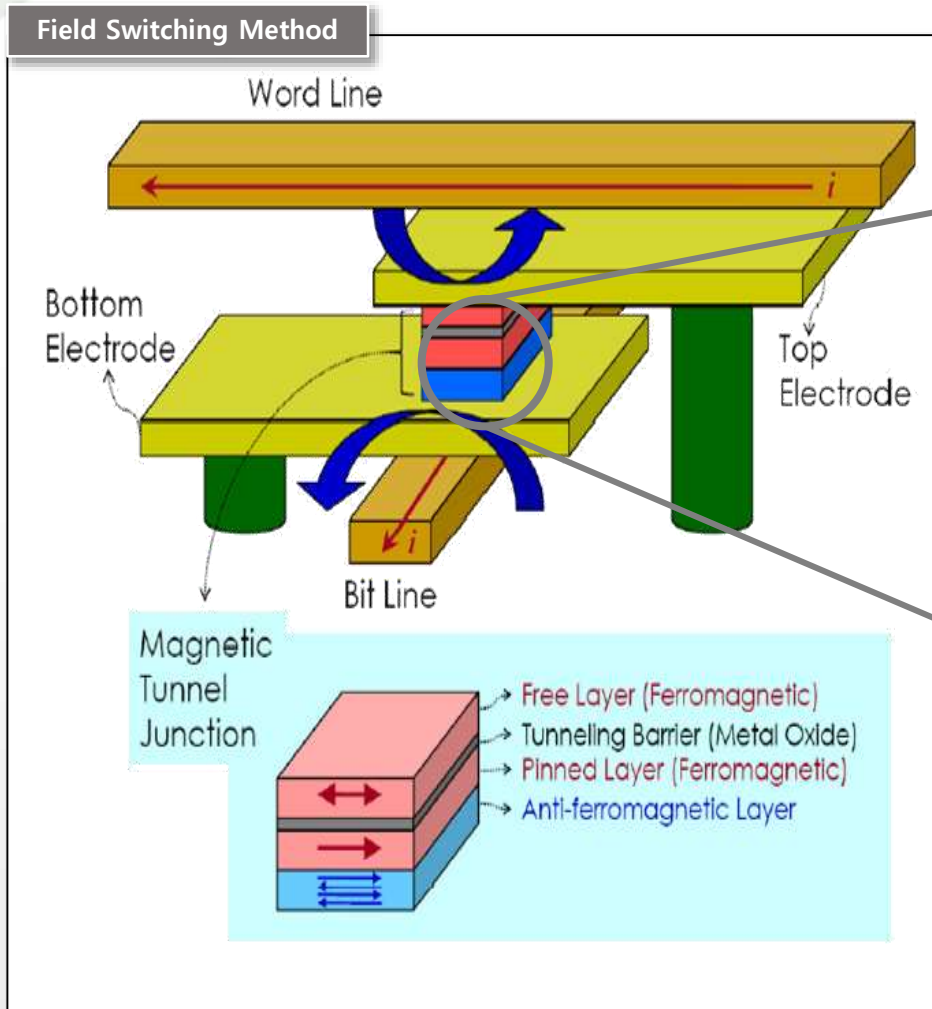
^bDestructive read and limited read/write endurance.

^cLimited write endurance.



NEW Memory

1. Conventional MRAM-Introduction

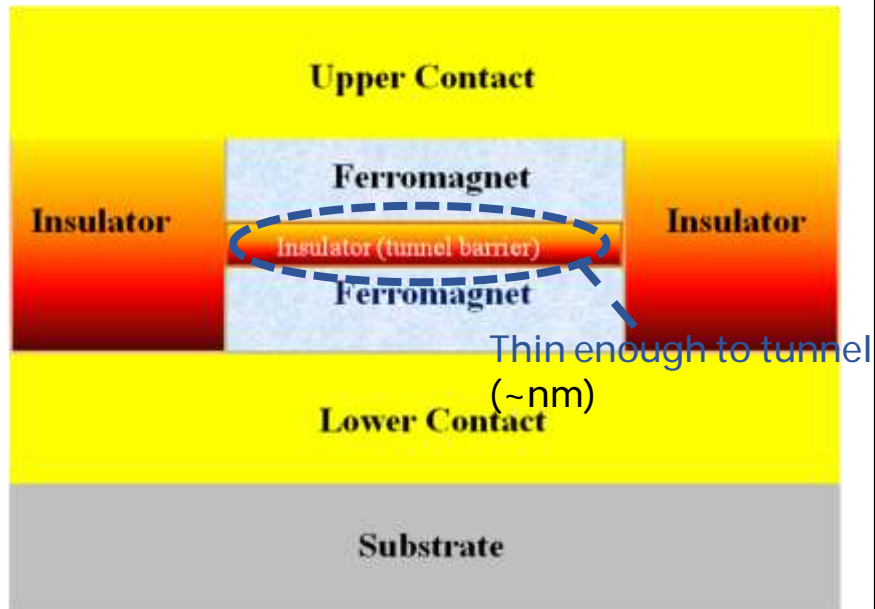


1. Conventional MRAM-Principles

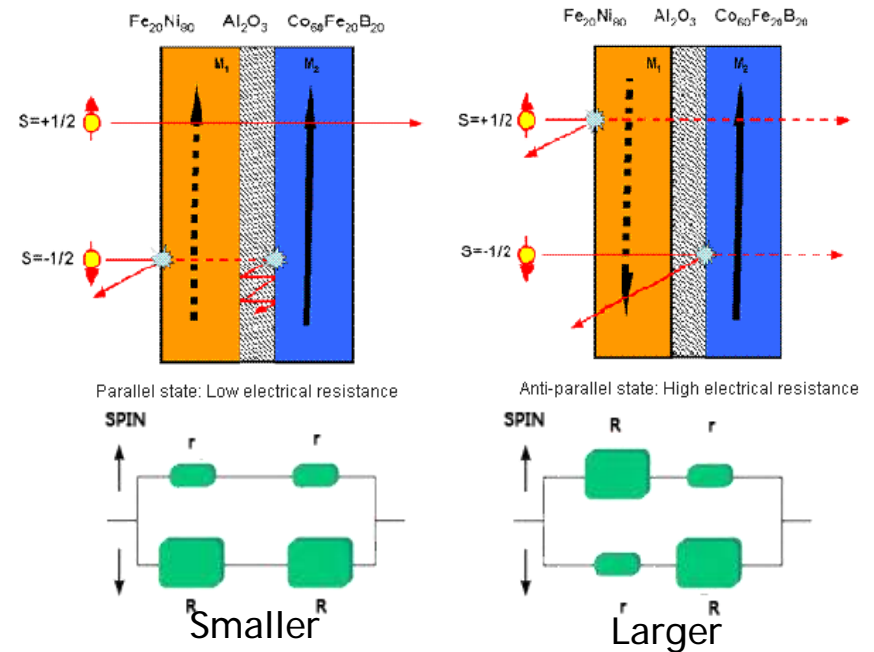


Magnetic Tunneling Junction

TMR = Magnetoresistive effect



Mott's Model



Spin-polarized conduction electron's scattering by antiparallel exchange coupling at the boundary

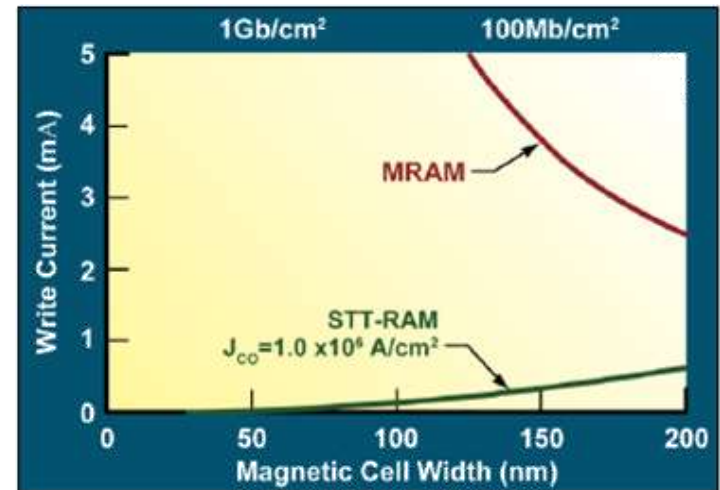
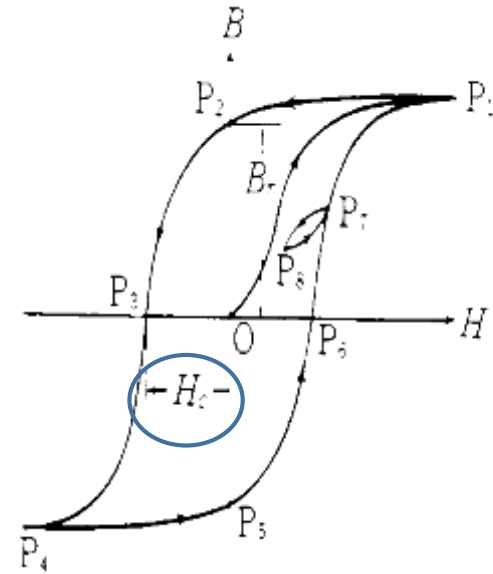
1. Conventional MRAM-Limitation



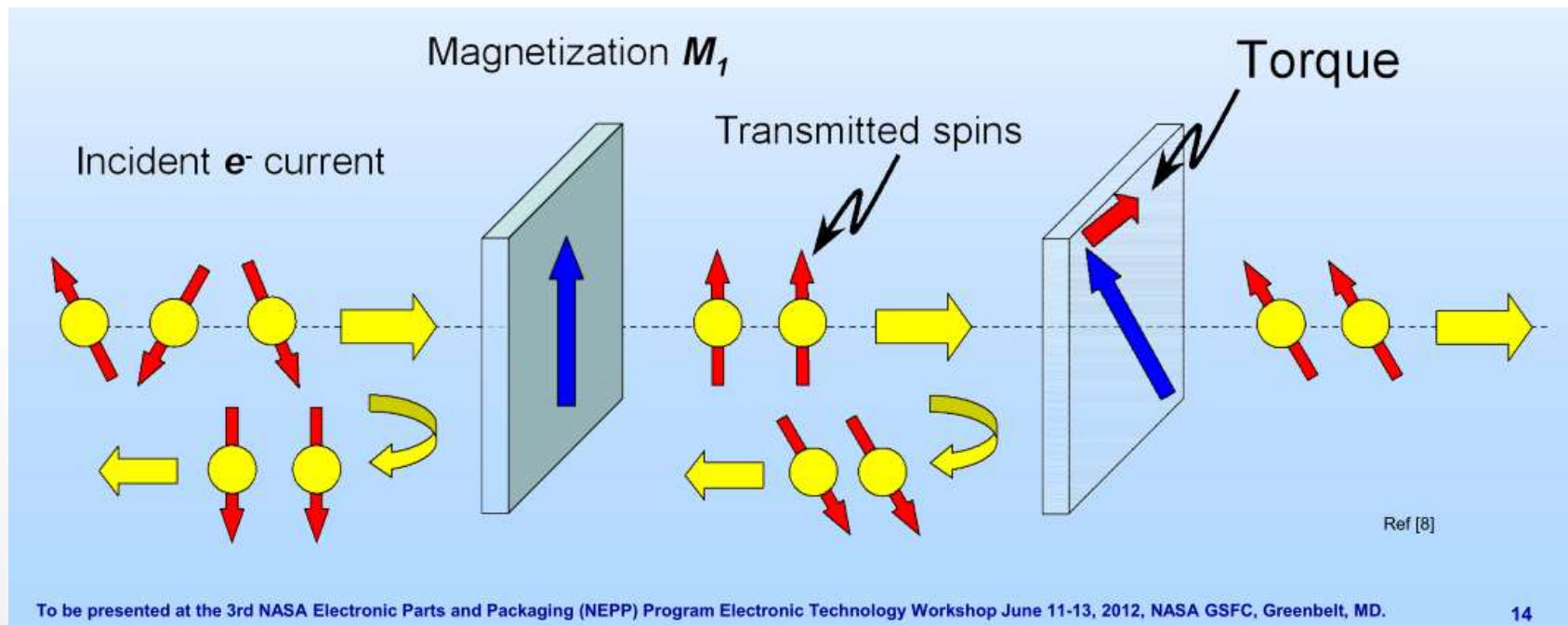
Limitation of Conventional MRAM

1. Scaling down =
increasing of power consumption
- High H_c
2. Thermal stability
- $\tau = \exp(\frac{K_U V}{k_B T}) / f_0$
3. Cross-talk

<Break Through>
STT-MRAM



2. STT MRAM-Principle



2. STT MRAM-Features



1. Simple structure
2. Lower power consumption
3. Multi-level cell capability

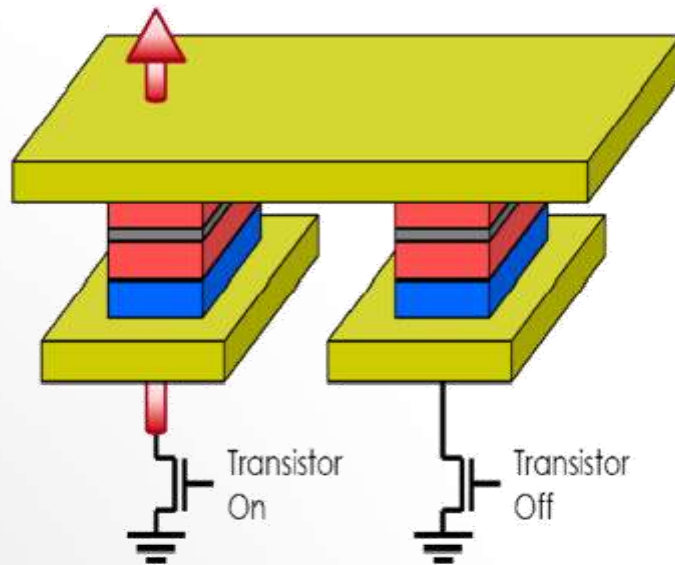
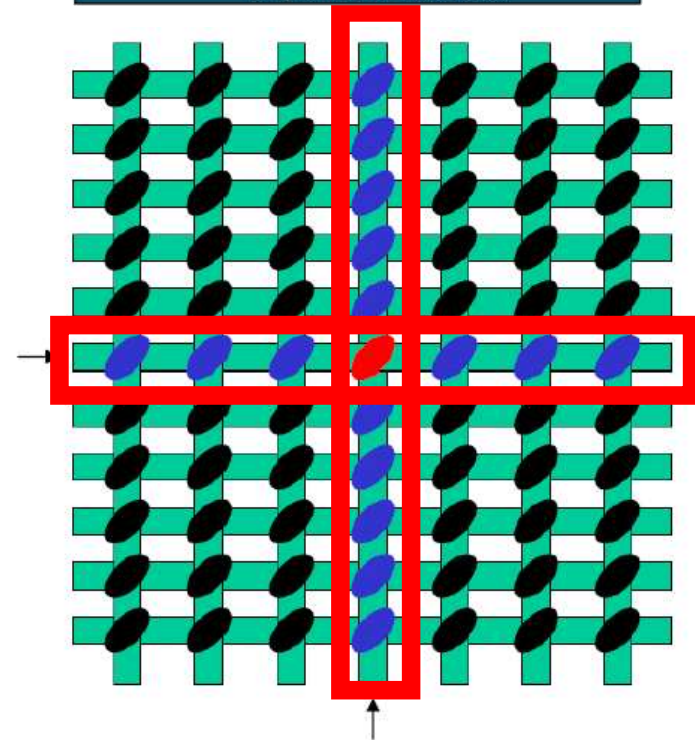
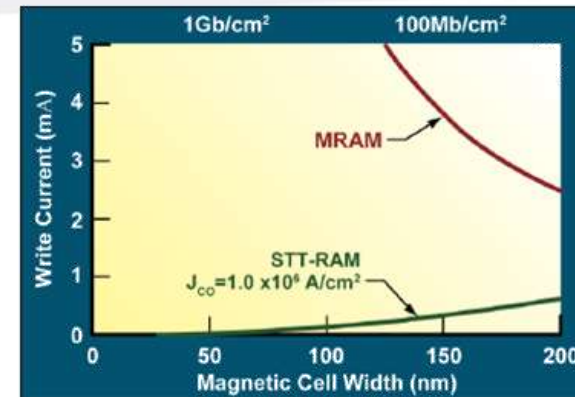


Fig. 6. Schematic illustration of structure STT-MRAM device. Red arrow indicates the flow of electric current.



Current flows to only one cell
There are no selective problem
and reading error



Q&A