

Spintronics devices using Spin Transfer Torque

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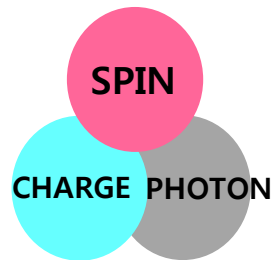
01 INTRODUCTION

02 PRINCIPLE – Spin Transfer Torque

03 APPLICATION – Magnetic domain wall MRAM

INTRODUCTION

Spintronics



: Spin based electronics
where the electron spin
carries information

History_STT

- In 1997,
Dr. Slonczewski of IBM &
Prof. Berger of univ. of Carnegie Mellon

➡ theoretically suggested

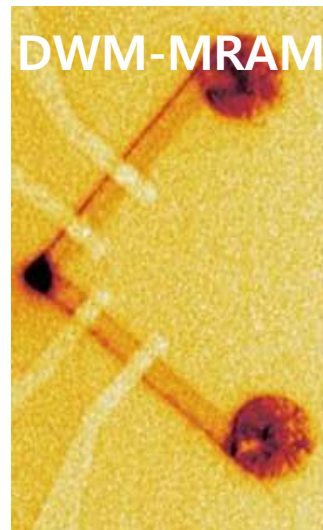
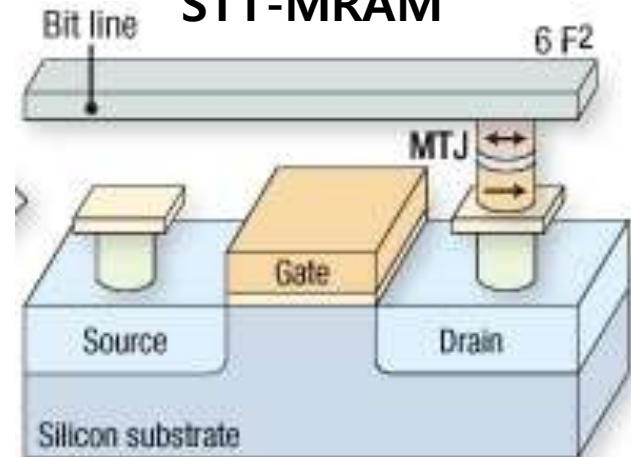
- During 15 years,
theoretical & experimental research

- From 2008,
Samsung electronics & SK Hynix

➡ STT-MRAM

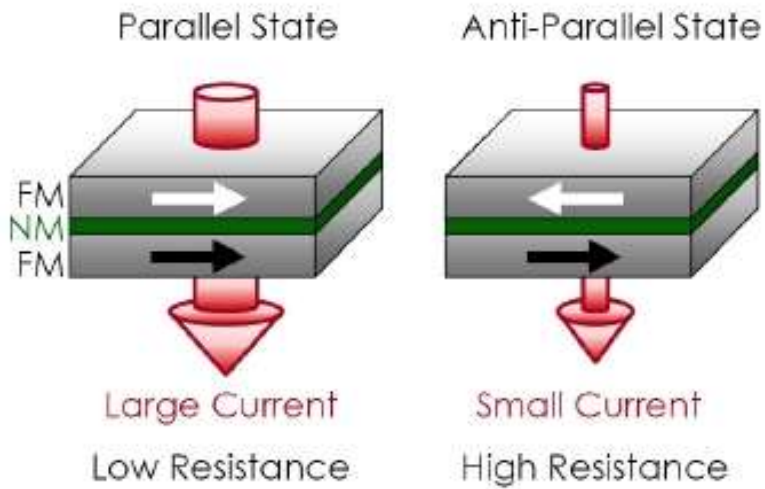
Application_STT

STT-MRAM



PRINCIPLE (GMR, STT)

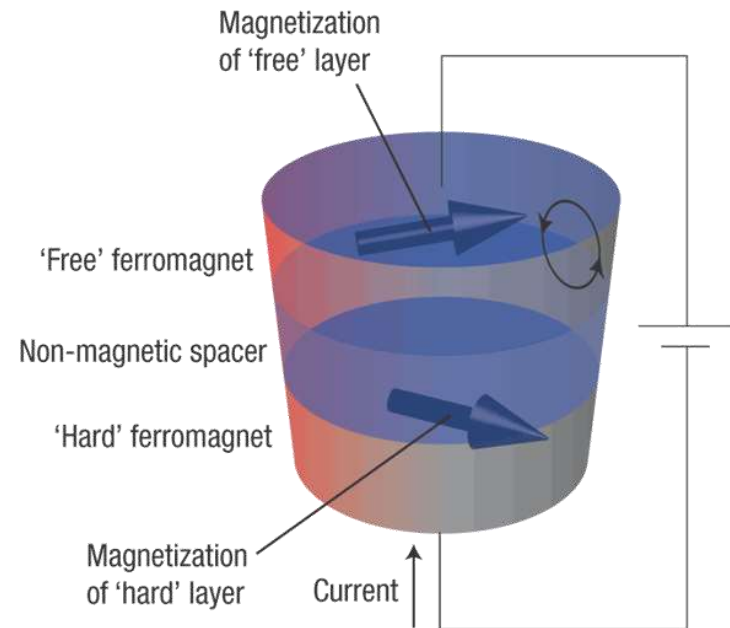
Giant Magneto-Resistance



Direction of magnetization

→ current

Spin Transfer Torque

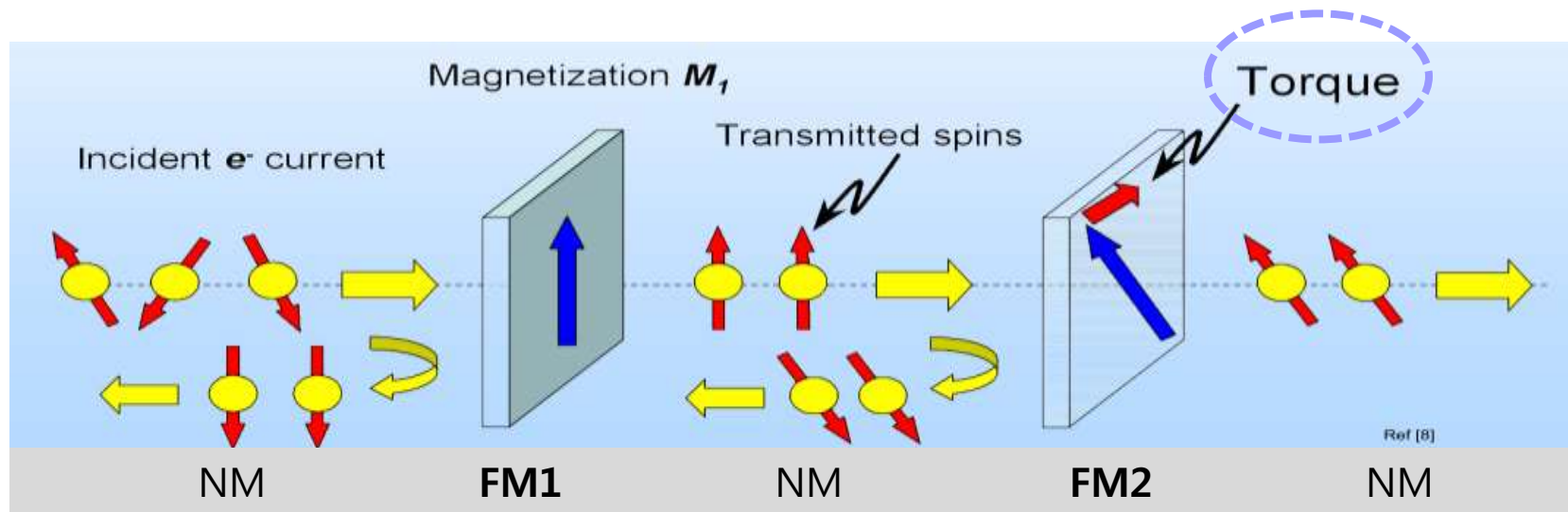


Spin polarized current

→ direction of magnetization

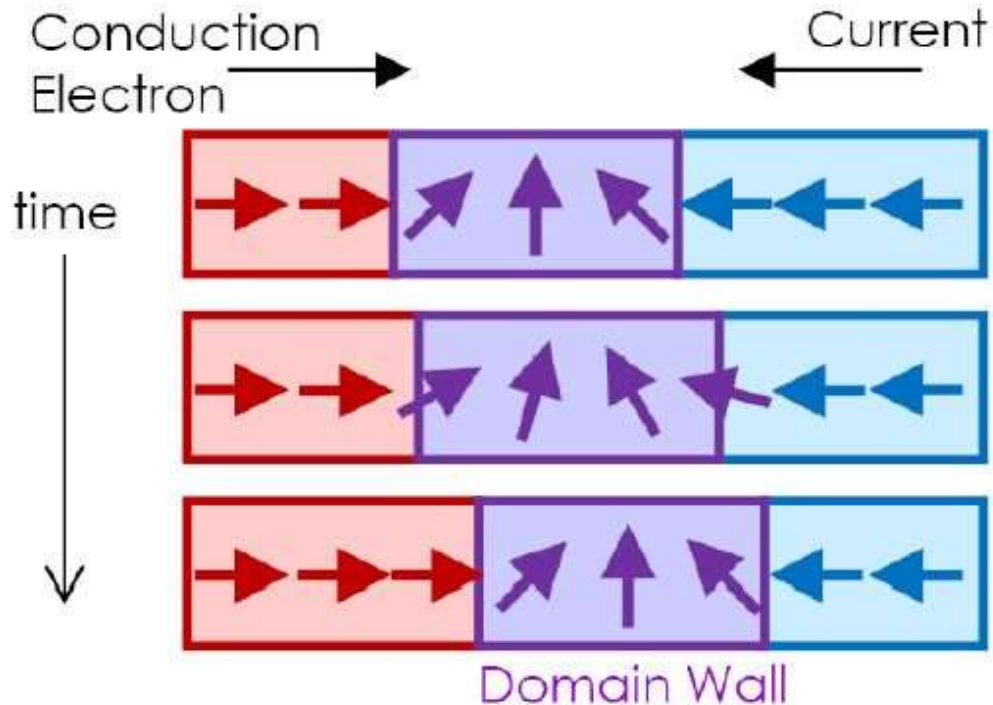
STT is reaction to GMR

PRINCIPLE (STT)



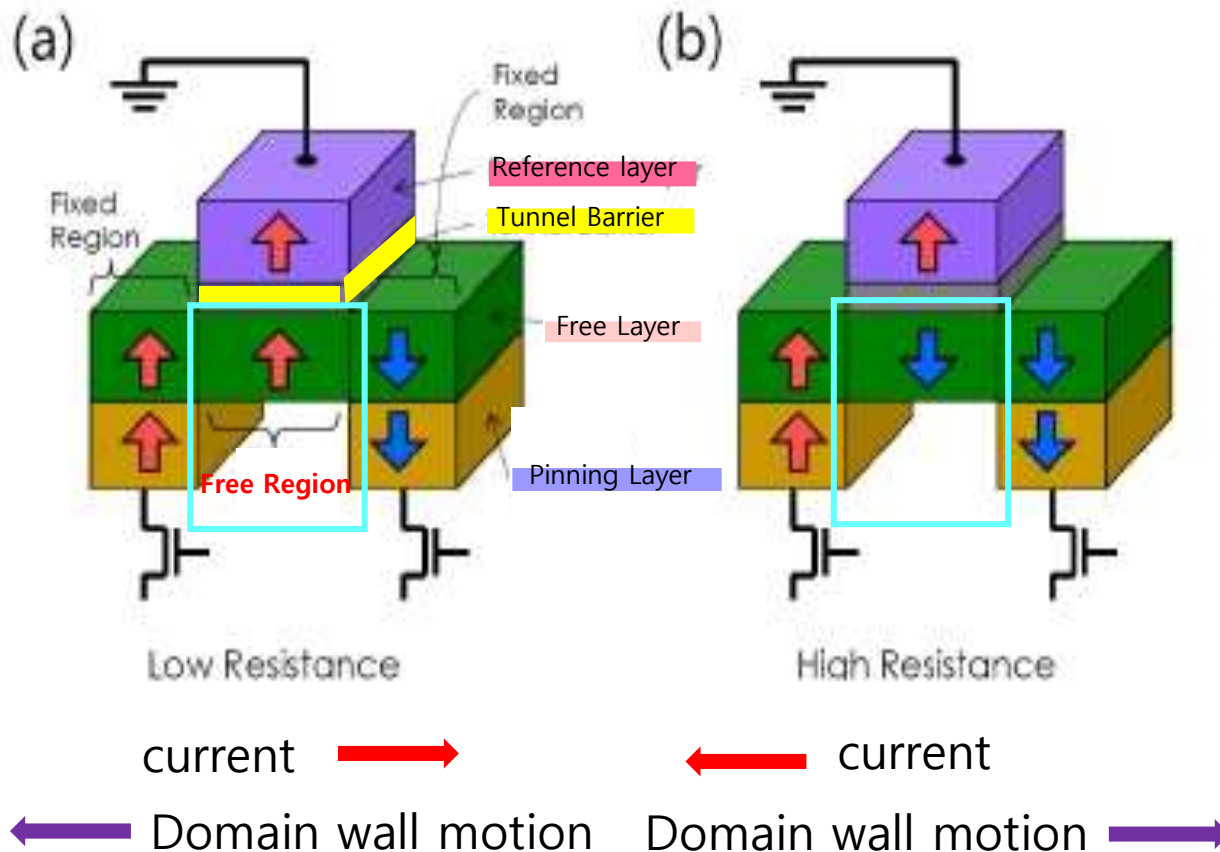
- Passage of current through a FM1 → **spin-polarization**
- Only up-spin is filtered : Spin-filtering
- Realignment of polarization
induce **torque**
change direction of magnetization

PRINCIPLE (STT)



- Current in magnetic material
→ spin polarized to direction of magnetization.
- Spin polarized current interacts with magnetization of material
→ making STT effect.
- Spin Transfer Torque
→ changing the direction of magnetization.

TREND (DWM-MRAM)

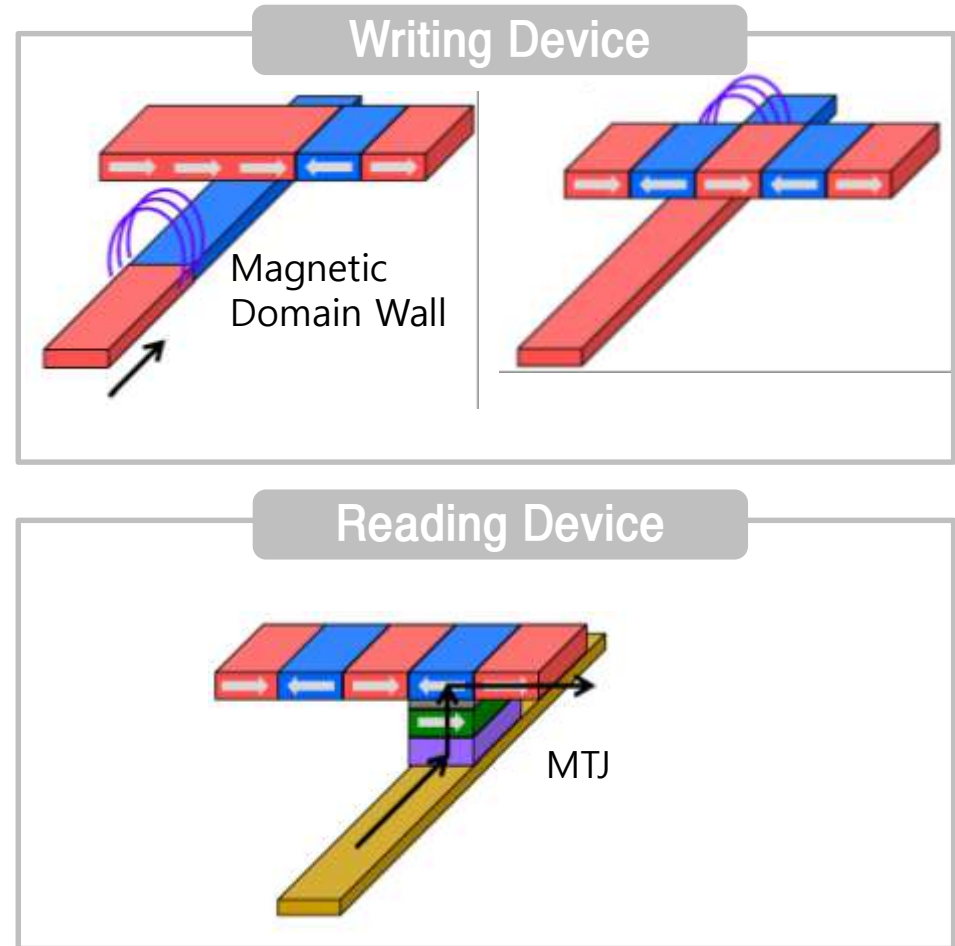
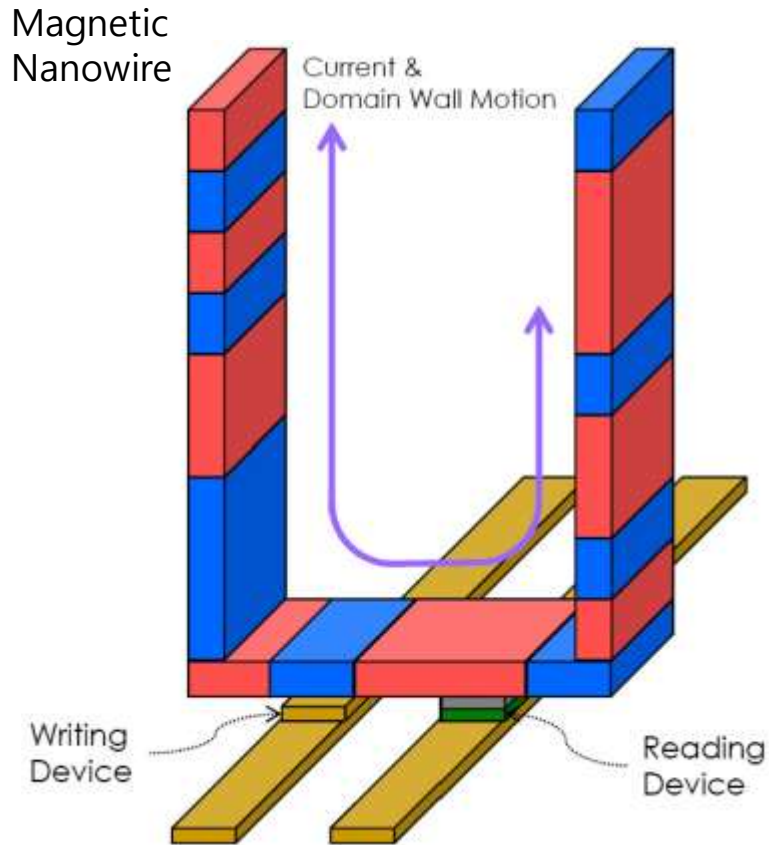


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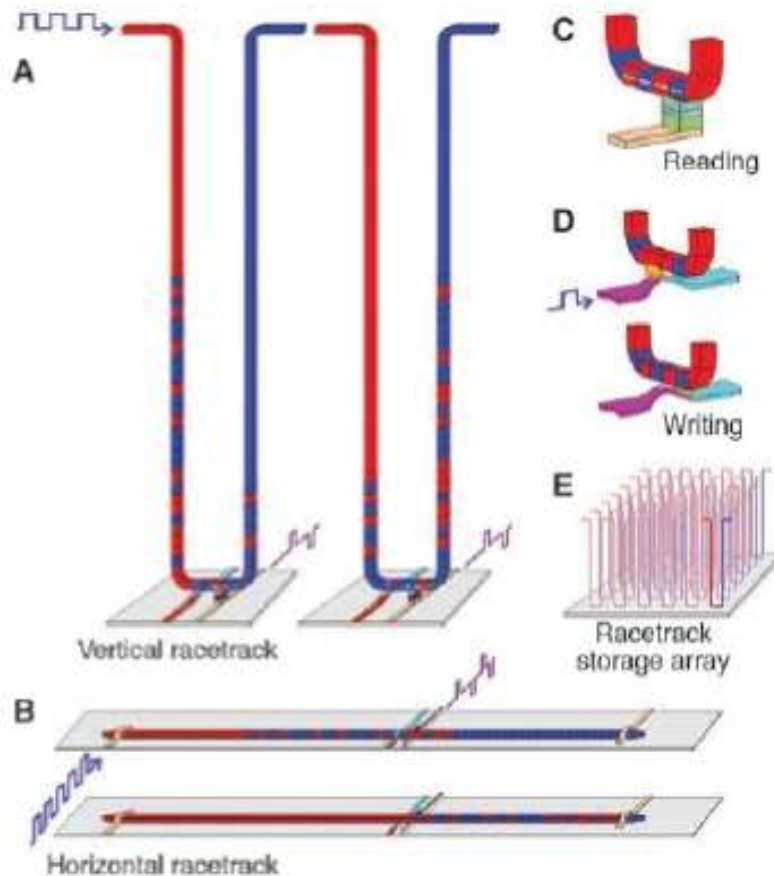
TREND (Magnetic racetrack memory)



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TREND (Magnetic racetrack memory)



Magnetic Racetrack Memory

- Array of magnetic nanowires
- Read up to 100 domain walls

Future research

- Need low driving current density
∴ Heat in nanowires

REFERENCE

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2. Stuart S.P. Parkin. Et al, Magnetic Domain-wall racetrack memory. science 320(2008)
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THANK YOU
