Introduction to Voltage-Controlled Spintronic Devices

Hochul Lee (Qualcomm)

Spintronics is an emerging scientific field that investigates the properties of electron spin and develops techniques for detecting and manipulating its associated magnetic moment within solid-state devices, alongside its fundamental electronic charge. The utilization of spintronic devices has gained attention as a potential alternative to conventional CMOS technology. Among these devices, magnetic tunnel junctions (MTJs) are particularly promising due to their noteworthy features such as non-volatility, virtually unlimited endurance, and compatibility with CMOS. Furthermore, the discovery of novel switching mechanisms like spin-transfer torque (STT) and spin Hall effect (SHE) has enabled the demonstration of nanosecond switching speeds in MTJ devices. Nonetheless, these methods, reliant on electrical currents, inherently result in significant ohmic loss since they necessitate a relatively large current to generate sufficient spin torque.

To address this energy concern, a recent development has introduced a voltage-controlled effect to alleviate ohmic dissipation during switching. This advancement is implemented in an innovative memory architecture known as magnetoelectric RAM (MeRAM). By substantially reducing ohmic dissipation, voltage-induced switching not only achieves higher energy efficiency but also brings about enhancements in terms of density and switching speed. Consequently, this paves the way for new possibilities in the development of low-power and high-speed system architectures for the next generation. Within this presentation, we will delve into the characteristics of voltage-controlled magnetic anisotropy (VCMA) effect-driven precessional switching based on MTJs and explore its application in MeRAM design. Furthermore, we will showcase an example of a voltage-controlled spintronics-CMOS hybrid circuit, namely an MTJ-based true-random number generator.

- 일시: 2023년 6월 26일 (월요일) 오전 10시 (대한민국 표준시)
- 장소: zoom (온라인)
  - https://sogang-ac-kr.zoom.us/j/84831470416?pwd=VFJJUWNuczdjaStZWnQ2ZzB4c2ZWZz09
  - 회의 ID: 848 3147 0416, 암호: 239102
- 연사 약력

  학력

  2001-2005: 고려대학교 전자공학부 학사

  2005-2007: 서울대학교 전기컴퓨터공학부 석사 (지도교수: 신형철)

  2012-2017: University of California Los Angeles 전자공학부 박사 (지도교수: Kang L. Wang)

  경력

  2007-2012: Samsung Electronics, 선임 연구원

  2015-2017: Inston Inc., Lead circuit design

  2017-2023: Qualcomm, Senior staff engineer