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Publications

PUBLICATIONS

- **Efficient Memory Integration: MRAM-SRAM Hybrid Accelerator for Sparse On-Device Learning** *Design Automation Conference*
Zhang, F., Wang, S., Tsai, W., Fan, D., Hwang, W., Xue, F.
2024
- **Atomic Layer Deposition of WO₃-doped In₂O₃ for Reliable and Scalable BEOL-Compatible Transistors** *Nature Communications*
Yoo, C., Tsai, W., Meng, ., McIntyre, P., Hartano, J., Saini, B.
2024
- **On-Device Continual Learning with STT-Assisted-SOT MRAM based In-Memory Computing** *IEEE TRANSACTIONS ON COMPUTER-AIDED DESIGN OF INTEGRATED CIRCUITS AND SYSTEMS*
Zhang, F., Tsai, W., Wang, S., Fan, D., Hwang, W., Xue, F.
2024
- **Dimensional Scaling of Ferroelectric Properties of Hafnia-Zirconia Thin Films: Electrode Interface Effects** *ACS Nano*
Huang, F., Saini, B., Tsai, W., Wong, P., McIntyre, P., Wong, S.
2024
- **Atomic Layer Deposition of WO₃-doped In₂O₃ for Reliable and Scalable BEOL-Compatible Transistors** *Nature Communications*
Yoo, C., Hartanto, J., Tsai, W., McIntyre, P.
2024
- **Thermal optimization of two-terminal SOT-MRAM** *Journal of Applied Physics*
Su, H., Tsai, W., Wang, S., Pop, E.
2024; 135
- **Experimental Demonstration of Field-Free STT-Assisted SOT-MRAM (SAS-MRAM) with Four Bits per SOT Programming Line** *VLSI Symposium*
Hwang, W., Xue, F., Tsai, W., Bao, X., Wang, S.
2024
- **Cryogenic investigation of polarization switching in ultra-thin HZO ferroelectric capacitors** *2023 Materials Research Society Fall Meeting*
Saini, B., Tsai, W., McIntyre, P.
2023
- **Mechanism of polarization "Wake-Up" in ferroelectric Hafnia-Zirconia thin films** *Solid State Electronics*
Saini, B., Choi, Y., Huang, F., Tsai, W., McIntyre, P.
2023
- **2-terminal SOT-MRAM at Deeply Scaled Technology Nodes with 1x nm MTJ Critical Dimension** *Stanford NMTRI*
Hwang, W., Tsai, W., Wang, S.
2023

- **Field-free spin-orbit torque switching assisted by in-plane unconventional spin torque in ultrathin [Pt/Co]N** *Nature Comm.*
Xue, F., Bao, X., Tsai, W., Wang, S.
2023
- **Energy-Efficient Computing With High-Density, Field-Free STT-Assisted SOT-MRAM** *IEEE TRANSACTIONS ON MAGNETICS*
Hwang, W., Tsai, W., Bao, X., Wang, S.
2023
- **Continual Learning with STT-Assisted-SOT MRAM based In-Memory Computing** *Design Automation Conference*
Zhang, F., Tsai, W., Wang, S., Fan, D.
2023
- **Atomic Layer Deposition of WOX-doped In₂O₃ for High-Performance BEOL-Compatible Transistors** *Materials Research Society, Fall 2023*
Yoo, C., Tsai, W., Baniecki, J., McIntyre, P.
2023
- **First Observation of Ultra-high Polarization (~108 $\mu\text{C}/\text{cm}^2$) in Nanometer Scaled High Performance Ferroelectric HZO Capacitors with Mo Electrodes** *VLSI Symposium*
Huang, F., Tsai, W., Wong, P., McIntyre, P.
2023
- **Enhanced spin-orbit torque by interfacial spin-orbit precession in Mg-capped Pt/Co in-plane system detected by spin-wave coupling** *Nature Materials*
Xue, F., Tsai, W., Hwang, W., Wang, S.
2023
- **Field-Induced Ferroelectric Phase Evolution During Polarization “Wake-Up” in Hf_{0.5}Zr_{0.5}O₂ Thin Film Capacitors** *Advanced Electronic Materials*
Saini, B., Baniecki, J., Tsai, W., McIntyre, P.
2023
- **Enhanced Switching Reliability of Hf_{0.5}Zr_{0.5}O₂ Ferroelectric Films 2 Induced by Interface Engineering** *ACS Appl. Mater. Interfaces*
Huang, F., Tsai, W., McIntyre, P., Wong, S.
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- **Cryogenic investigation of polarization switching in ultra-thin HZO ferroelectric capacitors** *Stanford Non-volatile Memory Technology Research Initiative 2023*
Saini, B., Tsai, W., McIntyre, P.
2023
- **Atomic Layer Deposition of WO₃ doped In₂O₃ for High Performance BEOL Compatible Transistors** *54th IEEE Semiconductor Interface Specialists Conference*
Yoo, C., Tsai, W., McIntyre, P.
2023
- **Unconventional materials and fabrications for high- density SOT-MRAM with multi-bit MTJs on shared SOT line** *Stanford NMTRI*
Xue, F., Tsai, W., Wang, S.
2023
- **Observation of anti-damping spin-orbit torques generated by in-plane and out-of-plane spin polarizations in MnPd₃** *Nature Materials*
DC, M., Hou, V., Xue, F., Lin, S., Tsai, W., Tsymbal, E., Wang, W., Wang, S. X.
2023
- **The Field-dependence Endurance Model and Its Mutual Effect in Hf-based Ferroelectrics** *International Reliability Conference*
Chang, Y., Tsai, W., McIntyre, P., Liao, P., Yu, Z., Lin, Y.
2022
- **New Ferroelectrics for Neuromorphic and Storage Class Memory**
Saini, B., Tsai, W., McIntyre, P.
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2022

- **Performance benchmarking of spin-orbit transfer magnetic RAM (SOT-MRAM) for deep neural network (DNN) accelerators** *International Memory Workshop*
Luo, Y., Yu, S., Wang, S., Tsai, W.
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- **CeO₂ Doping of Hf_{0.5}Zr_{0.5}O₂ Thin Films for High Endurance Ferroelectric Memories** *Adv. Electron. Mater.*
Yu, Z., Wong, P., Tsai, W., McIntyre, P., Baniecki, J., Chang, C., Mehta, A.
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- **Phase Evolution with Wake-Up Effect in HZO Thin Film Capacitors using Synchrotron X-ray Diffraction** *Semiconductor Interface Specialists Conference*
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- **Nanocrystallite Seeding of Metastable Ferroelectric Phase Formation in Atomic Layer-Deposited Hafnia-Zirconia Alloys** *ACS Applied Materials & Interfaces*
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2022
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Hwang, W., Bao, X., Tsai, W., Wang, S.
2022
- **Wake-up Free, BEOL Compatible, Low Operation Voltage (1.2 V), and High Endurance HZO FeRAM Scaled to 40 nm × 40 nm Size with Mo Electrodes** *IEDM*
Huang, F., Tsai, W., Wong, H., McIntyre, P., Wong, S.
2022
- **Energy Efficient Computing with High Density, Field Free STT Assisted SOT MRAM (SAS)** *TMRC*
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- **Experimental Demonstration of BEOL-Compatible, Field-Free STT-Assisted SOT-MRAM (SAS-MRAM) with One or Multiple Bits per SOT Programming Line** *IEDM 2022*
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2022
- **Low Temperature (350 °C) Annealing for Ferroelectric Hf_{0.5}Zr_{0.5}O₂ Thin Films** *Materials Research Society 2021. Late news*
Yu, Y., Tsai, W., McIntyre, P.
2021
- **High-Performance BEOL-Compatible Atomic-Layer-Deposited In₂O₃ Fe-FETs Enabled by Channel Length Scaling down to 7 nm: Achieving Performance Enhancement with Large Memory Window of 2.2 V, Long Retention > 10 years and High Endurance > 1e8 Cycles** *IEDM*
Lin, Z., Tsai, W., McIntyre, P., Ye, P.
2021
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- **CeO₂-Doped Hf_{0.5}Zr_{0.5}O₂ Ferroelectrics for High Endurance Embedded Memory Applications** *IEDM*
Yu, Y., Wong, P., Tsai, W., McIntyre, P.
2021
- **Spin-orbit torques of an in-plane magnetized system modulated by the spin transport in the ferromagnetic Co layer** *Applied Physics Letters*
Xue, F., Tsai, W., Wang, S.
2021
- **Tunable Spin-Orbit Torque Efficiency in In-plane and Perpendicular Magnetized [Pt/Co]_n Multilayer** *Applied Physics Letters*

- Xue, F., Tsai, W., Wang, S.
2021
- **Observation of anti-damping spin-orbit torques generated by in-plane and out-of-plane spin polarizations in antiferromagnetic MnPd₃** *Nature Materials*
DC, M., Tsai, W., Wang, S.
2021
 - **Materials Requirements of High-Speed and Low-Power Spin-Orbit-Torque Magnetic Random-Access Memory** *Journal of the Electron Devices Society*
Li, X., Wang, S., Tsai, W., Lin, S.
2020
 - **Memory Technologies for Emerging Computing Applications** *Strategic Materials Conference*
Tsai, W., McIntyre, P., Wang, S., Kummel, A., Datta, S.
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 - **Large and Robust Charge-to-Spin Conversion in Sputtered Weyl Semimetal WTe₂ with Structural Disorder** *Nature Materials*
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2020
 - **Emerging Memory Devices**, *2019 IRDS Roadmap, Beyond CMOS*
Li, X., Lin, S., Tsai, W.
2020
 - **Accelerating Deep Neural Networks in Processing-in-Memory Platforms: Analog or Digital Approach?** *IEEE Computer Society Annual Symposium on VLSI*
Fan, D., Lin, S., Tsai, W.
2019
 - **Performance Benchmarking of p-type In_{0.65}Ga_{0.35}As/GaAs_{0.4}Sb_{0.6} and Ge/Ge_{0.93}Sn_{0.07} Hetero-junction Tunnel FETs** *IEDM*
Pandey, R., Datta, S., Tsai, W.
2016
 - **Record high current density and low contact resistance in MoS₂ FETs by ion doping** *VLSI-TSA Symposium*
Fathipour, S., Seabaugh, A., Yeh, L., Tsai, W.
2016
 - **Demonstration of Black Phosphorous P-MOSFETs with h-BN/Al₂O₃ Bilayer Gate Dielectric: Achieving Ion = 850μA/μm, gm = 340μS/μm, EOT = 2nm and Rc = 0.58kΩ•μm** *IEDM*
Yang, L., Ye, P., Yeh, L., Tsai, W.
2016
 - **CHALLENGES AND PROGRESS IN III-V MOSFETs FOR CMOS CIRCUITS** *International Journal of High Speed Electronics and Systems*
Tsai, W., Lee, J., OKTYABRSKY, S., KOVESHNIKOV, S.
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 - **Performance comparison of sub 1 nm sputtered TiN/HfO₂ nMOS and pMOSFETs** *IEDM*
Tsai, W., Ragnarsson, L., Heyns, M.
2003
 - **Variation of composition of sputtered TiN films as a function of target nitridation, thermal anneal, and substrate topography** *Appl. Phys. Lett.*
Tsai, W., Delfino, M.
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