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Enabling Advanced MRAM Testing at NY CREATES with Hprobe's IBEX Platform

Overview

NY CREATES is actively developing both STT-MRAM and SOT-MRAM technologies at the device R&D and process development stages. In this context, achieving accurate, repeatable, and scalable magnetic testing is essential to support technology development and prepare for future manufacturing.

To address these needs, NY CREATES deployed Hprobe's IBEX wafer-level test platform, a turnkey solution combining 3D magnetic field generation, high-speed electrical testing, and full automation.

The Challenge

Prior to adopting Hprobe's solution, magnetic testing capabilities at NY CREATES were limited to a 2T inline magnet with simple one-dimensional field projection. This setup enabled basic magnetic stimulation but did not support more advanced use cases.

In practice, characterization relied on purely electrical switching measurements, without magnetic field supplementation. As MRAM technologies evolved, this approach became limiting, particularly for SOT-MRAM.

One of the key challenges was the inability to apply controlled magnetic fields in the plane of the device (Hx and Hy). As a result, SOT-MRAM devices could not be properly measured, since their switching behavior depends on in-plane magnetic conditions.

At the same time, ensuring repeatability across wafers and consistency between R&D and process development activities became increasingly important.

Requirements

To support its MRAM roadmap, NY CREATES required a test solution capable of delivering:

- High repeatability across experiments and wafers
- Wafer-level integration for consistent cross-wafer measurements
- Accurate multi-axis magnetic field control (X, Y, Z)

- Combined magnetic and electrical testing
- Support for high-speed pulsed measurements

These capabilities were necessary to move beyond basic characterization and enable a deeper understanding of device behavior.

Hprobe's Solution

NY CREATES implemented Hprobe's IBEX ATE platform, designed specifically for magnetic device testing at the wafer level.

Hprobe's IBEX platform helped bridge the gap between advanced magnetic characterization requirements and the need for a more scalable test environment supporting both R&D and process development. By combining precise 3D magnetic field control, high-speed test capabilities, and wafer-level automation, the platform enabled NY CREATES to perform more accurate, repeatable, and efficient characterization of next-generation MRAM devices.

At the core of the system is the H3DM robotized test head, mounted on a wafer prober and integrating a proprietary 3D magnetic field generator. This enables controlled magnetic field application along all three axes, with field strengths up to 600 mT in the perpendicular direction and 100 mT in-plane, while maintaining good field uniformity over the device area.

The platform also integrates a complete electrical test environment, including waveform generation, amplification, and measurement instrumentation, all controlled through a modular software environment for sequencing, parameter extraction, and multi-device management.

A key component is the RF Spin module, which enables advanced pulsed measurements. It supports pulse widths from 200 picoseconds to 200 nanoseconds, synchronized dual-channel operation with sub-100 picosecond timing, and fast bit error rate testing with millions of cycles completed in seconds.

"As we advance both STT-MRAM and SOT-MRAM development at NY CREATES, having a test platform that combines precise 3D magnetic field control with high-speed electrical measurements is essential. Hprobe's IBEX system has enabled us to significantly improve the confidence and repeatability of our characterization, while making it possible to fully evaluate SOT-MRAM devices for the first time. This is a key step in supporting both our R&D and process development activities. Beyond the technology itself, we also appreciated the close collaboration and responsiveness of the Hprobe team throughout the project. Their

expertise in magnetic testing helped us quickly adopt the platform and maximize its value for our development programs", said NY CREATES Associate Vice President for Business Development Frank Tolic.

A key success factor was the close alignment between NY CREATES' technology roadmap and Hprobe's testing capabilities. The combination of advanced magnetic field generation, RF pulsed characterization, and wafer-level automation allowed the platform to address both current R&D needs and evolving process development requirements.

Results and Benefits

The deployment of IBEX has significantly improved MRAM testing capabilities at NY CREATES.

First, it enables simultaneous magnetic and electrical characterization, providing a more complete view of device behavior compared to previous electrical-only approaches. This has led to improved confidence in measurement results.

Second, the platform makes it possible to accurately characterize SOT-MRAM devices, thanks to precise control of magnetic fields along the X and Y axes.

Third, the system allows controlled sweeping of magnetic fields—both perpendicular and in-plane—while monitoring device resistance. This enables extraction of hysteresis curves, providing direct insight into switching behavior and data retention.

In addition, wafer-level integration ensures consistent and repeatable measurements across the wafer, supporting both R&D and process development activities.

This project demonstrates how advanced magnetic testing can accelerate the transition from device research to process development and future manufacturing. Working together, Hprobe and NY CREATES established a scalable test infrastructure supporting the next generation of MRAM technologies. The collaboration has also contributed to maturing the technology and generating the characterization data required to support engagement with industrial partners and prepare these devices for future commercial adoption.

Advantages Over Previous Approaches

Compared to earlier methods, the IBEX platform provides a fully integrated and controlled test environment.

Previous approaches relied either on inline DC switching or on standalone electrical characterization tools with limited pulsing capabilities. These methods did not allow combined magnetic and electrical testing under controlled conditions.

Alternative setups would have required combining multiple instruments, often leading to accurate electrical measurements but less reliable magnetic field control.

In contrast, IBEX delivers a turnkey solution, integrating 3D magnetic field generation and electrical testing in a single platform, ensuring consistency, accuracy, and ease of use.

Future Outlook

As MRAM technologies continue to evolve, testing requirements are expanding toward more advanced use cases such as magnetic immunity testing, which requires precise control of magnetic field strength and angle in three dimensions.

Hprobe's platform already supports this type of testing through adjustable magnetic field orientation and strength, enabling angle-resolved measurements.

Beyond MRAM, the system can also be used for other memory technologies. In particular, the RF modules support ReRAM testing, extending the applicability of the platform within NY CREATES' broader ecosystem.

Conclusion

By deploying Hprobe's IBEX platform, NY CREATES has significantly enhanced its MRAM testing capabilities.

The combination of accurate 3D magnetic field generation, high-speed pulsed electrical testing, and wafer-level automation enables more reliable characterization, supports process development, and prepares the path toward future manufacturing.

This integrated approach provides the level of control and repeatability required for next-generation memory technologies, including both STT-MRAM and SOT-MRAM.

About NY CREATES: NY CREATES serves as a lab-to-fab bridge for advanced electronics, fostering public-private and industry-academic partnerships for technology development and innovation. It attracts and leads industry-connected innovation and commercialization projects that secure significant investment, advance R&D in emerging technologies, and generate jobs. NY CREATES operates advanced facilities, with more than 2,700 experts and over $20 billion in managed investments.

About Hprobe: Founded in 2017 and based in Grenoble, France, Hprobe is part of Mycronic's Global Technologies division. Originating as a spin-off from SPINTEC, the company provides advanced magnetic test solutions for the semiconductor industry and is a global leader in this field. It designs automated wafer-level testing systems for magnetic devices such as MRAM and sensors, enabling precise and repeatable testing from R&D to production.

About Mycronic: Mycronic is a Swedish high-tech company specializing in production equipment for the electronics industry. Headquartered in Täby, Sweden, the company operates globally and is listed on Nasdaq Stockholm.