MicroSense

KerrMapper S/V-300

Mapping the Magnetic Properties of GMR, TMR, Longitudinal MRAM wafers up to 300 mm

The KerrMapper family of tools utilizes the longitudinal Magneto-Optical Kerr Effect (MOKE) to characterize the magnetic properties of magnetic multi-layer wafers for GMR/TMR heads, MRAM, and other magnetic sensors. Utilizing a non-contact full-wafer measurement technique, the KerrMapper S-300 and V-300 systems create a map of the magnetic properties of entire wafers. Both systems are available in a manual-loading or fully-automated configuration for use in R&D and/or production. Using the proprietary direct field control technique of MicroSense magnetic metrology tools, KerrMapper systems offer high field capabilities and low field resolution to characterize free and pinned layer properties in a single system.

BENEFITS

- Non-contact mapping of the magnetic properties of MRAM, MR, GMR, TMR and other wafers up to 300mm.
- Automatic skew and angular dispersion mapping for post-deposition and anneal process feedback.
- Measurement of patterned magnetic features using integrated Optical Pattern Recognition (OPR) hardware and software with measurement spot sizes from the micron to the millimeter range.
- Characterization of multi-layer soft and hard magnetic films.
- Vector field capability for measurement of Stoner-Wohlfarth astroids, complex bias field and other measurements.

MAGNETIC CHARACTERIZATION

The KerrMapper S/V-300 technology is based on the longitudinal Kerr effect and utilizes MicroSense proprietary direct field control system. This makes it possible to properly measure thin films used in advanced GMR/TMR read heads, MRAM, as well as soft magnetic materials. Active Field Control ensures no field overshoot or pole tip remanence influencing the measurement, even if high fields have been used to saturate the entire magnetic stack.
Thus, it is possible to map the spatial variation of both the pinned (Figure 1) and free (Figure 2) magnetic properties over the entire wafer by simply running different measurement recipes.
Utilizing the small spot configuration, the system can be used to measure pattern wafers.

PROCESS CONTROL

The system measures full hysteresis loops of the wafer. Proprietary extraction software automatically computes a large variety of parameters, such as pinned layer exchange, coercivity, free layer exchange, coercivity, anisotropy field, etc. The mapping results are displayed both graphically and in tables and can be saved to a network (Figure 3).

MODULAR DESIGN

Wafer Handling Robot with pre-aligner: This combined hardware/software option makes the tool fully automated for use in volume production. Using an integrated industry-standard robot and pre-aligner, wafers can be measured without having to manually be handled in a cassette.

Camera-Based Vision System: By utilizing a joystick-based user-friendly software interface, high resolution camera and optics, it is possible to visualize the exact location of the wafer to be measured. The vision system is designed to work in conjunction with small and ultra small laser spot sizes. The pixel size of the wafer location image is less than 2 microns.

Optical Pattern Recognition System: The OPR Module makes it possible to automatically locate and move to structures on a patterned wafer. Using this capability, patterned wafers can be automatically measured without operator involvement.

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Angular Dispersion and Skew Mapping: When performing an angular hysteresis loop measurement at a family of angles around the magnetic hard (easy) axis over the wafer surface an then extracting the angle at which a parameter, such as the anisotropy field is maximum, the resulting map is called a skew angle map (Figure 4). The easy (hard) axis dispersion measurement capability allows users to perform a fully automated mapping measurement of the angular dependence of any parameter, which gives critical process feedback.

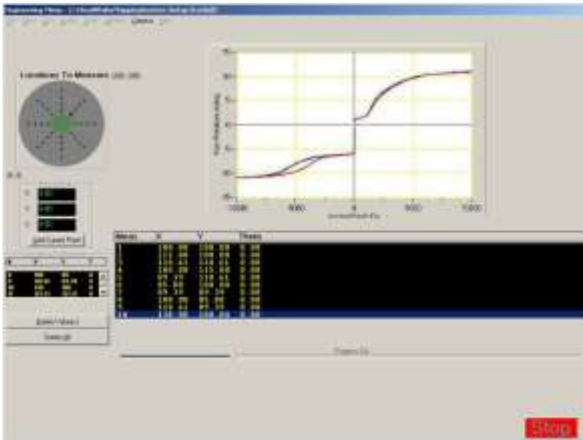

Figure 1. High Field (Full Stack) Measurement of TMR Multi-Layer Film.

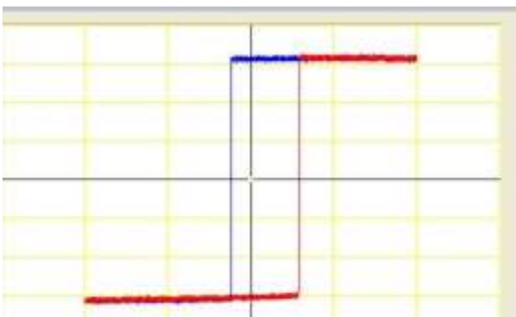

Figure 2. Low Field (Free Layer) Measurement of TMR Multi-Layer Film.

Full Wafer Temperature-Dependent Measurement: Using the wafer heat option, wafers up to 300 mm can be heated from room temperature to 250 C, wafers up to 200 mm can be heated up to 300 C with 1% uniformity, 1 C accuracy. This field upgradable option is fully integrated into the system both from a hardware and software perspective, including automated wafer handling, angular-dependent measurements, camera/OPR, recipe creation, engineering and production measurements and macro software module. Critical temperature and other complex temperature and/or time-dependent measurements can be easily set up thereby significantly extending the metrology capabilities of the KerrMapper S-300 measurement platform (Figure **5**).

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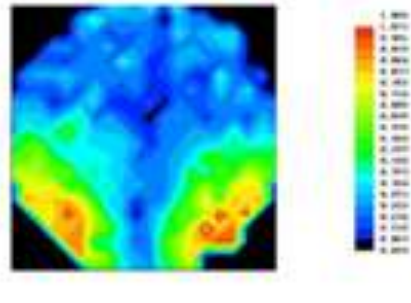

Figure 3. Full Wafer Maps Analyze Magnetic Uniformity of all Magnetic Layers of the Wafer Stack.

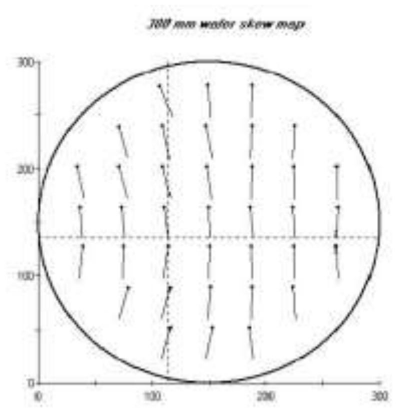

Figure 4. Automatic Skew Angle Mapping of Wafers.

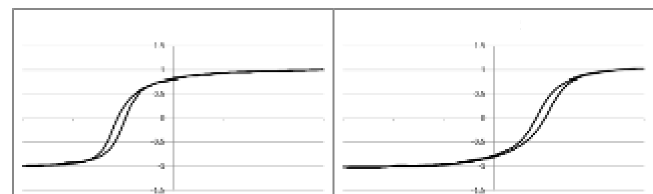

Figure 5. Measurement of a bi-layer Wafer Below and Above the Critical Temperature using the Wafer Heat Option.

Specifications are subject to change at any time without notice.
For more information on MicroSense Magnetic Metrology Systems please visit
www.microsense.net