CLAIMS

1. A metrology tool, comprising:

a magnet to generate a magnetic field;

a stage system to position a plurality of magnetic random-access memory (MRAM) dies on an MRAM wafer in the magnetic field,

wherein each MRAM die is a fully or partially fabricated MRAM device;

wherein each MRAM die has an orientation with respect to the polarization of a laser beam reflected from the MRAM die, the orientation being predetermined to provide a sufficient signal-to-noise ratio for magneto-optic Kerr effect (MOKE) measurements; and

wherein the stage system comprises a chuck on which to mount the MRAM wafer;

optics to provide the laser beam and direct the laser beam to be incident upon respective MRAM dies on the MRAM wafer with the respective MRAM dies positioned in the magnetic field, the laser beam having a plane of polarization;

a detector to receive the laser beam as reflected by the respective MRAM dies on the MRAM wafer and to measure rotation of the plane of polarization of the reflected laser beam;

one or more processors; and

memory storing one or more programs for execution by the one or more processors,

wherein the one or more programs comprise instructions for:

positioning the laser beam incident on each MRAM die in the magnetic field and in a common orientation between the plane of polarization of the laser beam and the orientation of the MRAM die;

measuring the rotation of the plane of polarization of the reflected laser beam from each of the MRAM die; and

reporting the measurement results,

wherein:

the chuck has a rotational axis;

the stage system has a first translational axis and a second translational axis; and

the stage system is configured to translate the chuck along the first and second translational axes and rotate the chuck about the rotational axis to position each MRAM die on the MRAM wafer to position the laser beam incident on the

MRAM die in the common orientation between the plane of polarization of the laser beam and the orientation of the MRAM die.

2. The tool of claim 1, wherein the stage system further comprises:

a first translational stage, to which the chuck is coupled, to translate the chuck along the first translational axis;

a first motor to move the first translational stage along the first translational axis;

a second translation stage, to which the first translational stage is coupled, to translate the chuck and the first translational stage along the second translational axis;

a second motor to move the second translational stage along the second translational axis; and

a third motor to rotate the chuck about the rotational axis.

3. The tool of claim 1, wherein the first and second translational axes are perpendicular.

4. The tool of claim 1, wherein:

the magnet is configured to generate the magnetic field to be normal to the respective MRAM dies on the MRAM wafer when the respective MRAM dies are positioned in the magnetic field; and

the optics are configured to direct the laser beam to be normally incident upon the respective MRAM dies on the MRAM wafer when the respective MRAM dies are positioned in the magnetic field.

5. The tool of claim 1, wherein:

the optics comprise a laser to generate the laser beam, a polarizer to polarize the laser beam with the plane of polarization, and mirrors to steer the laser beam to be incident upon the respective MRAM dies on the MRAM wafer; and

the detector comprises an analyzer.

6. The tool of claim 5, wherein:

the laser and polarizer are rotatable about their respective longitudinal axes to vary the plane of polarization of the laser beam; and

the detector is rotatable in accordance with rotation of the laser and polarizer.

7. The tool of claim 6, wherein:

the chuck has a rotational axis;

the stage system has a first translational axis; and

the stage system is configured to translate the chuck along the first axis and rotate the chuck about the rotational axis to position each MRAM die on the MRAM wafer to receive the laser beam.

8. A method, comprising, in a metrology tool:

for each of a plurality of magnetic random-access memory (MRAM) dies of an MRAM wafer, determining an orientation with respect to the polarization of a laser beam reflected from the MRAM die, wherein the orientation of the MRAM die provides a sufficient signal-to-noise ratio for magneto-optic Kerr effect (MOKE) measurements;

generating a magnetic field;

positioning the MRAM wafer in the magnetic field;

with the MRAM wafer positioned in the magnetic field, providing the laser beam to be incident upon the MRAM wafer, the laser beam having a plane of polarization;

successively positioning each MRAM die of the MRAM wafer so that the laser beam is incident on the MRAM die in a common orientation between the plane of polarization of the laser beam and the orientation of the MRAM die; and

for each MRAM die, measuring rotation of the plane of polarization of the laser beam as reflected by the MRAM die.

9. The method of claim 8, further comprising mounting the MRAM wafer on a chuck, wherein successively positioning the respective MRAM dies comprises:

rotating the chuck; and

translating the chuck along a first translational axis and along a second translational axis.

10. The method of claim 9, wherein the first and second translational axes are perpendicular.

11. The method of claim 8, wherein:

providing the laser beam comprises directing the laser beam to be normally incident on the respective MRAM dies; and

generating the magnetic field comprises configuring the magnetic field to be normal to the respective MRAM dies.

12. The method of claim 8, wherein providing the laser beam comprises:

generating the laser beam using a laser; and

polarizing the laser beam to have the plane of polarization, using a polarizer.

13. The method of claim 12, wherein the orienting comprises rotating the laser and the polarizer about their respective longitudinal axes to vary the plane of polarization.

14. The method of claim 13, wherein successively positioning the respective MRAM dies comprises:

rotating a chuck; and

translating the chuck along a single translational axis.

15. The method of claim 13, wherein:

the measuring is performed using a detector; and

the method further comprises rotating the detector in accordance with the rotating of the laser and the polarizer.

16. A metrology tool, comprising:

a magnet to generate a magnetic field;

a stage system to position a plurality of magnetic random-access memory (MRAM) dies on an MRAM wafer in the magnetic field,

wherein each MRAM die includes an orientation with respect to the polarization of a laser beam reflected from the MRAM die, the orientation of the MRAM die being predetermined to provide a sufficient signal-to-noise ratio for magneto-optic Kerr effect (MOKE) measurements; and

wherein the stage system comprises a chuck on which to mount the MRAM wafer;

optics to provide the laser beam and direct the laser beam to be incident upon respective MRAM dies on the MRAM wafer with the respective MRAM dies positioned in the magnetic field, the laser beam having a plane of polarization;

a detector to receive the laser beam as reflected by the respective MRAM dies on the MRAM wafer and to measure rotation of the plane of polarization of the reflected laser beam;

one or more processors; and

memory storing one or more programs for execution by the one or more processors, the one or more programs comprising instructions for:

moving each MRAM die on the MRAM wafer to a common orientation with respect to the plane of polarization of the laser beam when the laser beam is incident on the MRAM die with the MRAM die positioned in the magnetic field; and

reporting the measured rotation of the plane of polarization of the reflected laser beam from each of the MRAM die.

17. A method, comprising, in a metrology tool:

generating a magnetic field;

positioning a magnetic random-access memory (MRAM) wafer in the magnetic field, the MRAM wafer comprising a plurality of MRAM dies, wherein each MRAM die includes an orientation with respect to the polarization of a laser beam reflected from the MRAM die, the orientation being predetermined to provide a sufficient signal-to-noise ratio for magneto-optic Kerr effect (MOKE) measurements;

with the MRAM wafer positioned in the magnetic field, providing the laser beam to be incident upon the MRAM wafer, wherein providing the laser beam comprises generating the laser beam using a laser and polarizing the laser beam using a polarizer to provide the laser beam with a plane of polarization;

rotating the MRAM wafer to orient the plurality of MRAM dies with a common orientation with respect to the plane of polarization of the laser beam;

with the MRAM wafer rotated to orient the plurality of MRAM dies with the common orientation, and while the MRAM wafer is positioned in the magnetic field, translating the MRAM wafer along first and second axes of translation to successively position each MRAM die of the plurality of MRAM dies to receive the laser beam;

receiving the laser beam as reflected by each MRAM die of the plurality of MRAM dies at a detector;

using the detector, measuring rotation of a second plane of polarization of the reflected laser beam with respect to the first plane of polarization of the laser beam as received by each MRAM die; and

reporting the measured rotation of the second plane of polarization of the reflected laser beam from each of the MRAM die.