

Claims

1. A measurement system comprising:
 - an illumination source configured to illuminate each of a plurality of metrology targets disposed a first plurality of locations on a wafer, the wafer also including a plurality of hot spot structures at a second plurality of locations on the wafer that are different from the first plurality of locations, the wafer being illuminated by the illumination source after an intermediate process step of a semiconductor wafer fabrication sequence;
 - a detector configured to detect an amount of light from each of the plurality of metrology targets in response to the illuminating of each of the plurality of metrology targets and generate an amount of measurement data based on the detected amounts of light; and
 - a computing system configured to:
 - determine a value of at least one parameter characterizing a hot spot structure of the plurality of hot spot structures based on the amount of measurement data and a trained hot spot measurement model; and
 - communicate a signal to a process tool that causes the process tool to adjust a process parameter associated with a fabrication process step of the semiconductor wafer fabrication sequence based on the value of the at least one parameter characterizing the hot spot structure.
2. The measurement system of claim 1, wherein the computing system is further configured to:
 - receive an indication of the plurality of hot spot structures at the second plurality of locations on the wafer;
 - receive an indication of the plurality of metrology targets at the first plurality of locations on the wafer;
 - receive an indication of a process window associated with one or more process parameters associated with any process step prior to and including the intermediate process step;

estimate a value of the at least one parameter characterizing the hot spot structure at each of a plurality of process points within the process window;
determine an amount of measurement data associated with a measurement of each of the plurality of metrology targets at each of the plurality of process points within the process window; and
train the hot spot measurement model based on the estimated value of the at least one parameter characterizing the hot spot structure at each of a plurality of process points within the process window and the amount of measurement data.

3. The measurement system of claim 2, wherein the estimating of the value of the at least one parameter characterizing the hot spot structure involves a simulation of a semiconductor fabrication model calibrated for the hot spot structure.

4. The measurement system of claim 2, wherein the estimating of the value of the at least one parameter characterizing the hot spot structure involves a measurement by a reference metrology system of the at least one parameter characterizing the hot spot structure repeatedly fabricated at each of a plurality of process points within the process window.

5. The measurement system of claim 2, wherein the one or more process parameters associated with the intermediate process step include lithography focus and lithography dosage.

6. The measurement system of claim 2, wherein the determining of the amount of measurement data associated with the measurement of each of the plurality of metrology targets involves a measurement of the plurality of metrology targets repeatedly fabricated at each of the plurality of process points within the process window.

7. The measurement system of claim 2, further comprising:

estimating a value of one or more parameters characterizing each of the plurality of metrology targets at each of the plurality of process points within the process window by a simulation of a semiconductor fabrication model, and wherein the determining the amount of measurement data associated with the measurement of each of the plurality of metrology targets is based on a simulation of a metrology target measurement model characterizing the measurement of each of the plurality of metrology targets by the measurement system at the value of the one or more parameters characterizing each of the plurality of metrology targets.

8. The measurement system of claim 1, wherein the plurality of hot spot structures include relatively dense structures and relatively isolated structures.

9. The measurement system of claim 1, wherein at least one of the plurality of metrology targets is an actual device structure.

10. The measurement system of claim 9, wherein the plurality of metrology targets includes any of a line-space grating, a FinFET structure, a SRAM device structure, a Flash structure, and a DRAM memory structure.

11. The measurement system of claim 1, wherein the hot spot measurement model is any of a linear model, a non-linear model, a polynomial model, a neural network model, a support vector machines model, a decision tree model, and a random forest model.

12. The measurement system of claim 1, wherein the plurality of metrology targets and the plurality of hot spot targets are the same type of structure.

13. The measurement system of claim 1, wherein the illuminating of each of the plurality of metrology targets and the detecting of the amount of light from each of the plurality of metrology targets includes measurements acquired by a plurality of different metrology techniques.

14. A measurement system comprising:

- an illumination source configured to illuminate each of a plurality of metrology targets disposed a first plurality of locations on a wafer, the wafer also including a plurality of hot spot structures at a second plurality of locations on the wafer that are different from the first plurality of locations, the wafer being illuminated by the illumination source after an intermediate process step of a semiconductor wafer fabrication sequence;
- a detector configured to detect an amount of light from each of the plurality of metrology targets in response to the illuminating of each of the plurality of metrology targets and generate an amount of measurement data based on the detected amounts of light; and
- a non-transitory computer readable medium storing an amount of program code that when executed by a computing system causes the computing system to:
 - determine a value of at least one parameter characterizing a hot spot structure of the plurality of hot spot structures based on the amount of measurement data and a trained hot spot measurement model; and
 - communicate a signal to a process tool that causes the process tool to adjust a process parameter associated with a fabrication process step of the semiconductor wafer fabrication sequence based on the value of the at least one parameter characterizing the hot spot structure.

15. The measurement system of claim **14**, wherein the amount of program code further causes the computing system to:

- receive an indication of the plurality of hot spot structures at the second plurality of locations on the wafer;
- receive an indication of the plurality of metrology targets at the first plurality of locations on the wafer;
- receive an indication of a process window associated with one or more process parameters associated with any process step prior to and including the intermediate process step;

estimate a value of the at least one parameter characterizing the hot spot structure at each of a plurality of process points within the process window;
determine an amount of measurement data associated with a measurement of each of the plurality of metrology targets at each of the plurality of process points within the process window; and
train the hot spot measurement model based on the estimated value of the at least one parameter characterizing the hot spot structure at each of a plurality of process points within the process window and the amount of measurement data.

16. A method comprising:

providing a wafer to a measurement system after an intermediate process step of a semiconductor wafer fabrication sequence, the wafer including a plurality of hot spot structures at a first plurality of locations on the wafer and a plurality of metrology targets at a second plurality of locations on the wafer that are different from the first plurality of locations;
illuminating each of the plurality of metrology targets at the second plurality of locations;
detecting an amount of light from each of the plurality of metrology targets in response to the illuminating of each of the plurality of metrology targets and generating an amount of measurement data based on the detected amounts of light;
determining a value of at least one parameter characterizing a hot spot structure by a computing system based on the amount of measurement data and a trained hot spot measurement model; and
communicating a signal to a process tool that causes the process tool to adjust a process parameter associated with a fabrication process step of the semiconductor wafer fabrication sequence based on the value of the at least one parameter characterizing the hot spot structure.

17. The method of claim **16**, further comprising:
receiving an indication of the plurality of hot spot structures at the first plurality of locations on the wafer;
receiving an indication of the plurality of metrology targets at the second plurality of locations on the wafer;
receiving an indication of a process window associated with one or more process parameters associated with any process step prior to and including the intermediate process step;
estimating a value of the at least one parameter characterizing a hot spot structure of the plurality of hot spot structures at each of a plurality of process points within the process window by the computing system;
determining an amount of measurement data associated with a measurement of each of the plurality of metrology targets at each of the plurality of process points within the process window by the computing system;
and
training the hot spot measurement model based on the estimated value of the at least one parameter characterizing the hot spot structure at each of a plurality of process points within the process window and the amount of measurement data by the computing system.

18. The method of claim **17**, wherein the estimating of the value of the at least one parameter characterizing the hot spot structure involves a simulation of a semiconductor fabrication model calibrated for the hot spot structure.

19. The method of claim **17**, wherein the one or more process parameters associated with the intermediate process step include lithography focus and lithography dosage.

20. The method of claim **16**, wherein at least one of the plurality of metrology targets is an actual device structure.