CLAIMS

1. A method comprising:

generating a first amount of broadband illumination light including wavelengths spanning a range from 2.5 micrometers to 12 micrometers from at least one laser sustained plasma (LSP) light source;

generating an amount of FTIR illumination light having a time varying spectrum from the first amount of the broadband illumination light that varies with time by dividing the broadband illumination light into a first optical path and a second optical path, the first optical path having a fixed optical path length and the second optical path having an optical path length that changes with a change of a position of a movable optical element;

directing the amount of FTIR illumination light to a FTIR measurement spot on a surface of a specimen under measurement at one or more angles of incidence, one or more azimuth angles, or a combination thereof, wherein a size of the FTIR measurement spot on the surface of the specimen is less than 50 micrometers;

collecting an amount of FTIR collected light from the FTIR measurement spot on the surface of the specimen in response to the amount of FTIR illumination light;

detecting the amount of FTIR collected light and generating FTIR output signals indicative of the detected FTIR collected light; and

determining a first estimated value of a first parameter of interest of the specimen under measurement based on the FTIR output signals and the time varying spectrum of the amount of FTIR illumination light.

2. The method of Claim 1, wherein the one or more angles of incidence does not include a normal angle of incidence.

3. The method of Claim 1, further comprising:

polarizing the amount of FTIR illumination light, the amount of FTIR collected light, or both.

4. The method of Claim 1, wherein the specimen under measurement includes a three dimensional NAND structure or a dynamic random access memory structure.

5. The method of Claim 1, further comprising:

directing a second amount of the broadband illumination light from the at least one LSP light source to a second measurement spot on the surface of the specimen under measurement at one or more angles of incidence, one or more azimuth angles, or a combination thereof;

collecting a second amount of collected light from the second measurement spot on the surface of the specimen in response to the second amount of the broadband illumination light;

detecting the second amount of collected light and generating second output signals indicative of the detected second amount of collected light; and

determining a second estimated value of a second parameter of interest of the specimen under measurement based on the second output signals.

6. The method of Claim 5, wherein the first and second parameters of interest are the same parameter of interest.

7. The method of Claim 5, wherein the second amount of the broadband illumination light includes second wavelengths different from first wavelength of the amount of FTIR illumination light.

8. The method of Claim 5, wherein the FTIR measurement spot and the second measurement spot are colocated.

9. The method of Claim 5, wherein the detecting of the second amount of collected light and the detecting of the amount of FTIR collected light occurs simultaneously.

10. A metrology system comprising:

a mid-infrared Fourier Transform Infrared (FTIR) spectrometer including:

one or more laser sustained plasma (LSP) light sources generating a first amount of broadband illumination light including wavelengths spanning a range from 2.5 micrometers to 12 micrometers;

an interferometer receiving the first amount of the broadband illumination light generated by the one or more LSP light sources and generating an amount of FTIR illumination light having a time varying spectrum that varies with time by dividing the broadband illumination light into a first optical path and a second optical path, the first optical path having a fixed optical path length and the second optical path having an optical path length that changes with a change of a position of a movable optical element;

an FTIR illumination optics subsystem directing the amount of FTIR illumination light from the interferometer to a FTIR measurement spot on a surface of a specimen under measurement at one or more angles of incidence, one or more azimuth angles, or a combination thereof, wherein a size of the FTIR measurement spot on the surface of the specimen is less than 50 micrometers;

a FTIR collection optics subsystem collecting an amount of FTIR collected light from the FTIR measurement spot on the surface of the specimen in response to the amount of FTIR illumination light;

at least one FTIR detector having a surface sensitive to incident light, the at least one FTIR detector detecting the amount of FTIR collected light and generating FTIR output signals indicative of the detected FTIR collected light; and

a computing system configured to generate a first estimated value of a first parameter of interest of the specimen under measurement based on the FTIR output signals and the time varying spectrum of the amount of FTIR illumination light.

11. The metrology system of Claim 10, wherein the one or more angles of incidence does not include a normal angle of incidence.

12. The metrology system of Claim 10, wherein a measurement channel of the mid-infrared FTIR spectrometer includes a polarizing

element in an illumination path, a collection path, or both, of the mid-infrared FTIR spectrometer.

13. The metrology system of Claim 10, further comprising:

a second metrology subsystem including:

a second illumination optics subsystem directing a second amount of the broadband illumination light from the one or more LSP light sources to a second measurement spot on the surface of the specimen under measurement at one or more angles of incidence, one or more azimuth angles, or a combination thereof;

a second collection optics subsystem collecting a second amount of collected light from the second measurement spot on the surface of the specimen in response to the second amount of the broadband illumination light;

at least one second detector having a second surface sensitive to incident light, the at least one second detector detecting the second amount of collected light and generating second output signals indicative of the detected second amount of collected light, wherein the computing system is further configured to generate a second estimated value of a second parameter of interest of the specimen under measurement based on the second output signals.

14. The metrology system of Claim 13, wherein the first and second parameters of interest are the same parameter of interest.

15. The metrology system of Claim 13, wherein the second amount of the broadband illumination light includes second wavelengths different from first wavelengths of the amount of FTIR illumination light.

16. The metrology system of Claim 13, wherein the FTIR measurement spot and the second measurement spot are colocated.

17. The metrology system of Claim 13, wherein the detecting of the second amount of collected light and the detecting of the amount of FTIR collected light occur simultaneously.