CLAIMS

WHAT IS CLAIMED IS:

1. An apparatus comprising:

a source of electromagnetic radiation in at least a first wavelength and a second wavelength;

a crystal having a high refractive index adapted to reflect the electromagnetic radiation in the at least first wavelength and second wavelength;

a reflector adapted to introduce the electromagnetic radiation in the at least first wavelength and second wavelength to the sample at a location across a range of angles including a critical angle between the crystal and the sample;

a detector for detecting a return electromagnetic radiation from each of the at least first wavelength and second wavelength from the sample.

2. The apparatus of claim **1** further comprising a housing adapted to contain the electromagnetic radiation source, crystal, reflector and detector.

3. The apparatus of claim **1** wherein the detector is a single element detector.

4. The apparatus of claim **1** wherein the detector is a single element mercury cadmium telluride detector.

5. The apparatus of claim **1** wherein the detector is a linear array detector.

6. The apparatus of claim **1** wherein the detector is a 2-dimensional array detector.

7. The apparatus of claim **1** wherein the electromagnetic radiation source is adapted to deliver an electromagnetic radiation to the sample at an angle of incidence below the critical angle.

8. The apparatus of claim 7 wherein the electromagnetic radiation source is further adapted to adjust an electromagnetic radiation delivered to the sample to approach and pass the critical angle.

9. The apparatus of claim 1 wherein the electromagnetic radiation source is adapted to deliver an electromagnetic radiation to the sample at an angle of incidence above the critical angle.

10. The apparatus of claim 9 wherein the electromagnetic radiation source is further adapted to adjust and electromagnetic radiation delivered to the sample to approach and pass the critical angle.

11. The apparatus of claim 1 further comprising a data processor in communication with the detector.

12. The apparatus of claim 11 wherein the data processor is further adapted to generate a critical angle map of the sample from one or more electromagnetic radiation detections received by the detector from the sample.

13. The apparatus of claim 1 wherein the electromagnetic radiation source is a quantum cascade laser.

14. The apparatus of claim 1 wherein the electromagnetic radiation is collimated.

15. The apparatus of claim 1 wherein the apparatus is less than 1 cubic foot in volume.

16. The apparatus of claim 1 wherein the apparatus is less than 125 cubic inches in volume.

17. The apparatus of claim 1 wherein the apparatus is handheld.

18. The apparatus of claim 1 wherein the apparatus is less than 8 cubic inches in volume.

19. The apparatus of claim **12** further comprising a display screen adapted and configured to display the critical angle map.

20. The apparatus of claim **11** wherein the data processor is adapted to generate a full map of reflected light intensity versus wavelength versus a mapping of the angle of incidence from the detected electromagnetic radiation.

21. The apparatus of claim **1** further comprising a drive mechanism adapted to pivot the crystal about an axis.

22. The apparatus of claim **1** further comprising a cooler adapted to cool the detector.

23. The apparatus of claim **1** further comprising a filter.

24. The apparatus of claim **1** further comprising a lens configured to image the electromagnetic radiation onto a detector area less than 1 mm^2.

25. A method for detecting the spectral characteristics of a sample comprising:

placing a sample in proximity to a crystal;

emitting an electromagnetic radiation from an electromagnetic radiation source in at least a first wavelength and a second wavelength through the crystal at a fixed or variable angle of incidence;

introducing the electromagnetic radiation in the at least first wavelength and second wavelength to the sample at a location through the crystal at an angle of incidence at or near a critical angle of the sample; and

detecting a return electromagnetic radiation from the at least first wavelength and second wavelength from the sample.

26. The method of claim **25** further comprising the steps of

introducing the electromagnetic radiation at an angle of incidence below the critical angle; and

increasing the angle of incidence of the electromagnetic radiation incrementally whereby the angle of incidence approaches and passes the critical angle.

27. The method of claim **26** further comprising the steps of

introducing the electromagnetic radiation at an angle of incidence above the critical angle; and

decreasing the angle of incidence of the electromagnetic radiation incrementally whereby the angle of incidence approaches and passes the critical angle.

28. The method of claim **26** further comprising the step of generating a full map of reflected light intensity versus wavelength versus a mapping of the angle of incidence.

29. The method of claim **28** further comprising the step of displaying a generated map.

30. The method of claim **26** further comprising the step of comparing the detected electromagnetic radiation to a database of critical angle measurements.

31. The method of claim **30** further comprising the step of displaying a detected electromagnetic radiation parameter and one or more critical angle measurements from the database.

32. The method of claim **25** further comprising the step of filtering the electromagnetic radiation.

33. The method of claim **25** further comprising the step of pivoting the crystal about an axis.

34. The method of claim **25** further comprising the step of cooling the detector.

35. The method of claim **25** further comprising the step of imaging the electromagnetic radiation onto a detector area less than 1 mm^2.

36. A networked apparatus comprising:

a memory;

a processor;

a communicator;

a display; and

an apparatus for detecting spectral characteristic comprising a source of electromagnetic radiation in at least a first wavelength and a second wavelength; a crystal having a high refractive index adapted to reflect the electromagnetic radiation from the at least first wavelength and second wavelength; a reflector adapted to introduce the electromagnetic radiation in the at least first wavelength and second wavelength to the sample at a location across a range of angles including a critical angle between the crystal and the sample; and a detector for detecting a return electromagnetic radiation from each of the at least first wavelength and second wavelength from the electromagnetic radiation from the sample.

37. A communication system, comprising:

an apparatus for detecting spectral characteristic comprising a source of electromagnetic radiation in at least a first wavelength and a second wavelength; a crystal having a high refractive index adapted to reflect the electromagnetic radiation from the at least first wavelength and second wavelength; a reflector adapted to introduce the electromagnetic radiation in the at least first wavelength and second wavelength to the sample at a location across a range of angles including a critical angle between the crystal and the sample; and a detector for detecting a return electromagnetic radiation from each of the at least first wavelength and second wavelength from the electromagnetic radiation from the sample;

a server computer system;

a measurement module on the server computer system for permitting the transmission of a measurement from a system for detecting spectral characteristics over a network;

at least one of an API engine connected to at least one of the system for detecting spectral characteristics and the device for detecting spectral characteristics to create an message about the measurement and transmit the message over an API integrated network to a recipient having a predetermined recipient user name, an SMS engine connected to at least one of the system for detecting spectral characteristics and the device for detecting spectral characteristics to create an SMS message about the measurement and transmit the SMS message over a network to a recipient device having a predetermined measurement recipient telephone number, and an email engine connected to at least one of the system for detecting spectral characteristics and the device for detecting spectral characteristics to create an email message about the measurement and transmit the email message over the network to a recipient email having a predetermined recipient email address.

38. The communication system of claim **37**, further comprising a storing module on the server computer system for storing the measurement on the system for detecting spectral characteristics server database.

39. The communications system of claim **38**, wherein at least one of the system for detecting spectral characteristics and the device for detecting spectral characteristics is connectable to the server computer system over at least one of a mobile phone network and an Internet network, and a browser on the measurement recipient electronic device is used to retrieve an interface on the server computer system.

40. The communications system of claim **38**, wherein a plurality of email addresses are held in a system for detecting spectral characteristics database and fewer than all the email addresses are individually selectable from the diagnostic host computer system, the email message being transmitted to at least one recipient email having at least one selected email address.

41. The communications system of claim **40**, wherein at least one of the system for detecting spectral characteristics and the device for detecting spectral characteristics is connectable to the server computer system over the Internet, and a

browser on the measurement recipient electronic device is used to retrieve an interface on the server computer system.

42. The communications system of claim **39**, wherein a plurality of user names are held in the system for detecting spectral characteristics database and fewer than all the user names are individually selectable from the diagnostic host computer system, the message being transmitted to at least one measurement recipient user name via an API.

43. The communications system of claim **42**, wherein the measurement recipient electronic device is connectable to the server computer system over the Internet, and a browser on the measurement recipient electronic device is used to retrieve an interface on the server computer system.

44. The communications system of claim **39**, wherein the measurement recipient electronic device is connected to the server computer system over a cellular phone network.

45. The communications system of claim **44**, wherein the measurement recipient electronic device is a mobile device.

46. The communications system of claim **45**, further comprising: an interface on the server computer system, the interface being retrievable by an application on the mobile device.

47. The communications system of claim **45**, wherein the SMS measurement is received by a message application on the mobile device.

48. The communications system of claim **47**, wherein a plurality of SMS measurements are received for the measurement, each by a respective message application on a respective recipient mobile device.

49. The communications system of claim **39**, wherein the at least one SMS engine receives an SMS response over the cellular phone SMS network from the mobile device and stores an SMS response on the server computer system.

50. The communications system of claim **49**, wherein a measurement recipient phone number ID is transmitted with the SMS measurement to the SMS engine and is used by the server computer system to associate the SMS measurement with the SMS response.

51. The communications system of claim **39**, wherein the server computer system is connectable over a cellular phone network to receive a response from the measurement recipient mobile device.

52. The communications system of claim **51**, wherein the SMS measurement includes a URL that is selectable at the measurement recipient mobile device to respond from the measurement recipient mobile device to the server computer system, the server computer system utilizing the URL to associate the response with the SMS measurement.

53. The communications system of claim **39**, further comprising:

a downloadable application residing on the measurement recipient mobile device, the downloadable application transmitting the response and a measurement recipient phone number ID over the cellular phone network to the server computer system, the server computer system utilizing the measurement recipient phone number ID to associate the response with the SMS measurement.

54. The communications system of claim **39**, further comprising:

a transmissions module that transmits the measurement over a network other than the cellular phone SMS network to a measurement recipient user computer system, in parallel with the measurement that is sent over the cellular phone SMS network.

55. The communication system of claim **39** further comprising

a downloadable application residing on the measurement recipient host computer, the downloadable application transmitting a response and a measurement recipient phone number ID over the cellular phone network to the server computer system, the server computer system utilizing the measurement recipient phone number ID to associate the response with the SMS measurement.

56. A networked apparatus comprising:

a memory;

a processor;

a communicator;

a display; and

an apparatus for detecting the spectral characteristics of a sample comprising an electromagnetic radiation source adapted to excite a sample with electromagnetic radiation, a crystal in communication with the electromagnetic radiation source and the sample, the crystal having a high refractive index adapted to reflect the electromagnetic radiation, a reflector adapted to introduce the electromagnetic radiation to the sample at a location at an angle of incidence at or near a critical angle between the crystal and the sample, and a detector for detecting an electromagnetic radiation from the sample.

57. A communication system, comprising:

an apparatus for detecting the spectral characteristics of a sample comprising an electromagnetic radiation source adapted to excite a sample with electromagnetic radiation, a crystal in communication with the electromagnetic radiation source and the sample, the crystal having a high refractive index adapted to reflect the electromagnetic radiation, a reflector adapted to introduce the electromagnetic radiation to the sample at a location at an angle of incidence at or near a critical angle between the crystal and the sample, and a detector for detecting an electromagnetic radiation from the sample;

a server computer system;

a measurement module on the server computer system for permitting the transmission of a measurement from a system for detecting spectral characteristics over a network;

at least one of an API engine connected to at least one of the system for detecting spectral characteristics and the device for detecting spectral characteristics to create an message about the measurement and transmit the message over an API integrated network to a recipient having a predetermined recipient user name, an SMS engine connected to at least one of the system for

detecting spectral characteristics and the device for detecting spectral characteristics to create an SMS message about the measurement and transmit the SMS message over a network to a recipient device having a predetermined measurement recipient telephone number, and an email engine connected to at least one of the system for detecting spectral characteristics and the device for detecting spectral characteristics to create an email message about the measurement and transmit the email message over the network to a recipient email having a predetermined recipient email address.

58. The communication system of claim **57**, further comprising a storing module on the server computer system for storing the measurement on the system for detecting spectral characteristics server database.

59. The communications system of claim **58**, wherein at least one of the system for detecting spectral characteristics and the device for detecting spectral characteristics is connectable to the server computer system over at least one of a mobile phone network and an Internet network, and a browser on the measurement recipient electronic device is used to retrieve an interface on the server computer system.

60. The communications system of claim **58**, wherein a plurality of email addresses are held in a system for detecting spectral characteristics database and fewer than all the email addresses are individually selectable from the diagnostic host computer system, the email message being transmitted to at least one recipient email having at least one selected email address.

61. The communications system of claim **60**, wherein at least one of the system for detecting spectral characteristics and the device for detecting spectral characteristics is connectable to the server computer system over the Internet, and a browser on the measurement recipient electronic device is used to retrieve an interface on the server computer system.

62. The communications system of claim **59**, wherein a plurality of user names are held in the system for detecting spectral characteristics database and fewer than all the user names are individually selectable from the diagnostic host computer

system, the message being transmitted to at least one measurement recipient user name via an API.

63. The communications system of claim **62**, wherein the measurement recipient electronic device is connectable to the server computer system over the Internet, and a browser on the measurement recipient electronic device is used to retrieve an interface on the server computer system.

64. The communications system of claim **62**, wherein the measurement recipient electronic device is connected to the server computer system over a cellular phone network.

65. The communications system of claim **64**, wherein the measurement recipient electronic device is a mobile device.

66. The communications system of claim **65**, further comprising: an interface on the server computer system, the interface being retrievable by an application on the mobile device.

67. The communications system of claim **65**, wherein the SMS measurement is received by a message application on the mobile device.

68. The communications system of claim **67**, wherein a plurality of SMS measurements are received for the measurement, each by a respective message application on a respective recipient mobile device.

69. The communications system of claim **59**, wherein the at least one SMS engine receives an SMS response over the cellular phone SMS network from the mobile device and stores an SMS response on the server computer system.

70. The communications system of claim **69**, wherein a measurement recipient phone number ID is transmitted with the SMS measurement to the SMS engine and is used by the server computer system to associate the SMS measurement with the SMS response.

71. The communications system of claim **59**, wherein the server computer system is connectable over a cellular phone network to receive a response from the measurement recipient mobile device.

72. The communications system of claim **53**, wherein the SMS measurement includes a URL that is selectable at the measurement recipient mobile device to respond from the measurement recipient mobile device to the server computer system, the server computer system utilizing the URL to associate the response with the SMS measurement.

73. The communications system of claim **59**, further comprising:

a downloadable application residing on the measurement recipient mobile device, the downloadable application transmitting the response and a measurement recipient phone number ID over the cellular phone network to the server computer system, the server computer system utilizing the measurement recipient phone number ID to associate the response with the SMS measurement.

74. The communications system of claim **59**, further comprising:

a transmissions module that transmits the measurement over a network other than the cellular phone SMS network to a measurement recipient user computer system, in parallel with the measurement that is sent over the cellular phone SMS network.

75. The communication system of claim **59** further comprising

a downloadable application residing on the measurement recipient host computer, the downloadable application transmitting a response and a measurement recipient phone number ID over the cellular phone network to the server computer system, the server computer system utilizing the measurement recipient phone number ID to associate the response with the SMS measurement.

CLAIMS

WHAT IS CLAIMED IS:

1. An apparatus comprising:

a source of electromagnetic radiation in at least a first wavelength and a second wavelength;

a crystal having a high refractive index adapted to reflect the electromagnetic radiation in the at least first wavelength and second wavelength;

a reflector adapted to introduce the electromagnetic radiation in the at least first wavelength and second wavelength to the sample at a location across a range of angles including a critical angle between the crystal and the sample;

a detector for detecting a return electromagnetic radiation from each of the at least first wavelength and second wavelength from the sample.

2. The apparatus of claim 1 further comprising a housing adapted to contain the electromagnetic radiation source, crystal, reflector and detector.

3. The apparatus of claim 1 wherein the detector is a single element detector.

4. The apparatus of claim 1 wherein the detector is a single element mercury cadmium telluride detector.

5. The apparatus of claim 1 wherein the detector is a linear array detector.

6. The apparatus of claim 1 wherein the detector is a 2-dimensional array detector.

7. The apparatus of claim 1 wherein the electromagnetic radiation source is adapted to deliver an electromagnetic radiation to the sample at an angle of incidence below the critical angle, and wherein the electromagnetic radiation source is further adapted to adjust the electromagnetic radiation delivered to the sample to approach and pass the critical angle.

8. The apparatus of claim 1,
wherein the electromagnetic radiation source is adapted to deliver an electromagnetic radiation to the sample at an angle of incidence above the critical angle, and
wherein the electromagnetic radiation source is further adapted to adjust the electromagnetic radiation delivered to the sample to approach and pass the critical angle.

9. The apparatus of claim 1 further comprising a data processor in communication with the detector, wherein the data processor is adapted to generate a critical angle map of the sample from one or more electromagnetic radiation detections received by the detector from the sample.

10. The apparatus of claim 1 further comprising a drive mechanism adapted to pivot the crystal about an axis.

11. The apparatus of claim 1 further comprising a cooler adapted to cool the detector.

12. The apparatus of claim 1 further comprising a filter.

13. The apparatus of claim 1 further comprising a lens configured to image the electromagnetic radiation onto a detector area less than 1 mm^2.

14. A method for detecting the spectral characteristics of a sample comprising:
placing a sample in proximity to a crystal;
emitting an electromagnetic radiation from an electromagnetic radiation source in at least a first wavelength and a second wavelength through the crystal at a fixed or variable angle of incidence;
introducing the electromagnetic radiation in the at least first wavelength and second wavelength to the sample at a location through the crystal at an angle of incidence at or near a critical angle of the sample; and

detecting a return electromagnetic radiation from the at least first wavelength and second wavelength from the sample.

15. The method of claim 14 further comprising the steps of introducing the electromagnetic radiation at an angle of incidence below the critical angle; and

increasing the angle of incidence of the electromagnetic radiation incrementally whereby the angle of incidence approaches and passes the critical angle.

16. The method of claim 15 further comprising the steps of introducing the electromagnetic radiation at an angle of incidence above the critical angle; and

decreasing the angle of incidence of the electromagnetic radiation incrementally whereby the angle of incidence approaches and passes the critical angle.

17. The method of claim 15 further comprising the step of generating a full map of reflected light intensity versus wavelength versus a mapping of the angle of incidence.

18. The method of claim 17 further comprising the step of displaying a generated map.

19. The method of claim 15 further comprising the step of comparing the detected electromagnetic radiation to a database of critical angle measurements.

20. The method of claim 19 further comprising the step of displaying a detected electromagnetic radiation parameter and one or more critical angle measurements from the database.