

The claims defining the invention are as follows:

1. A method for measuring a photoluminescence response from an object, the method comprising the steps of:
 - (i) exposing the object to solar irradiation to generate photoluminescence from the
5 object;
 - (ii) measuring first and second signals from the object in first and second spectral bands, each of the measured first and second signals having a photoluminescence component and a background component, wherein the first and second spectral bands are selected such that the ratio of the photoluminescence component to the background component is higher in the first
10 measured signal than in the second measured signal; and
 - (iii) differencing the first and second measured signals to obtain a difference signal having an increased ratio of the photoluminescence component to the background component compared to the first measured signal.
2. The method according to claim 1, further comprising the step of interpreting the
15 difference signal to obtain information on one or more properties of the object.
3. The method according to claim 1 or claim 2, wherein the first and second signals are measured with an image capture device.
4. The method according to claim 3, further comprising the step of displaying the difference signal as a difference image.
- 20 5. The method according to any one of claims 1 to 4, further comprising the step of applying a scaling factor to the first measured signal or the second measured signal prior to the differencing step.
6. The method according to any one of claims 1 to 5, wherein the first spectral band is overlapping with a peak region of a photoluminescence response of the object.
- 25 7. The method according to any one of claims 1 to 6, wherein the first spectral band is overlapping with an atmospheric absorption band in the spectrum of the solar irradiation.
8. The method according to any one of claims 1 to 7, wherein the first and second spectral bands are provided by bandpass filters or equivalent filter combinations.
9. The method according to any one of claims 1 to 8, wherein the object comprises silicon.

10. The method according to claim 9, wherein the object comprises a photovoltaic module comprising a plurality of silicon photovoltaic cells.
11. The method according to claim 9 or claim 10, wherein the first spectral band is centred around a wavelength in the range 1120 to 1160 nm.
- 5 12. The method according to any one of claims 9 to 11, wherein the second spectral band is centred around a wavelength in the range 1160 to 1250 nm.
13. The method according to any one of claims 9 to 11, wherein the second spectral band is centred around a wavelength in the range 1000 to 1120 nm.
14. An apparatus for measuring a photoluminescence response from an object exposed to
10 solar irradiation, the apparatus comprising:
a measurement system for measuring first and second signals from an object exposed to solar irradiation, the first and second signals being measured in first and second spectral bands and each having a photoluminescence component generated by the solar irradiation and a background component, wherein the first and second spectral bands are selected such that the
15 ratio of the photoluminescence component to the background component is higher in the first measured signal than in the second measured signal; and
a computer for differencing the first and second measured signals to obtain a difference signal having an increased ratio of the photoluminescence component to the background component compared to the first measured signal.
- 20 15. The apparatus according to claim 14, wherein the computer is configured to interpret the difference signal to obtain information on one or more properties of the object.
16. The apparatus according to claim 14 or claim 15, wherein the measurement system comprises an image capture device.
17. The apparatus according to claim 16, wherein the apparatus comprises a display for
25 displaying the difference signal as a difference image.
18. The apparatus according to any one of claims 14 to 17, wherein the computer is configured to apply a scaling factor to the first measured signal or the second measured signal prior to the differencing step.

19. The apparatus according to any one of claims 14 to 18, wherein the measurement system comprises one or more filters selected such that the first spectral band is overlapping with a peak region of a photoluminescence response of the object.
20. The apparatus according to any one of claims 14 to 19, wherein the measurement
5 system comprises one or more filters selected such that the first spectral band is overlapping with an atmospheric absorption band in the spectrum of the solar irradiation.
21. The apparatus according to any one of claims 14 to 20, wherein the measurement system comprises one or more bandpass filters or equivalent filter combinations.
22. The apparatus according to any one of claims 14 to 21, wherein the apparatus is
10 configured for measuring a photoluminescence response from an object comprising silicon.
23. The apparatus according to claim 22, wherein the apparatus is configured for measuring a photoluminescence response from an object comprising a photovoltaic module comprising a plurality of silicon photovoltaic cells.
24. The apparatus according to claim 22 or claim 23, wherein the measurement system is
15 configured such that the first spectral band is centred around a wavelength in the range 1120 to 1160 nm.
25. The apparatus according to any one of claims 22 to 24, wherein the measurement system is configured such that the second spectral band is centred around a wavelength in the range 1160 to 1250 nm.
- 20 26. The apparatus according to any one of claims 22 to 24, wherein the measurement system is configured such that the second spectral band is centred around a wavelength in the range 1000 to 1120 nm.
27. A method for measuring a photoluminescence response from an object, the method comprising the steps of:
- 25 (i) exposing the object to solar irradiation to generate photoluminescence from the object; and
- (ii) measuring a signal from the object in a spectral band selected such that at least 20% of the measured signal comprises photoluminescence generated from the object by the solar irradiation.

28. The method according to claim 27, wherein the spectral band is selected such that at least 50% of the measured signal comprises photoluminescence generated from the object by the solar irradiation.
29. The method according to claim 28, wherein the spectral band is selected such that at least 80% of the measured signal comprises photoluminescence generated from the object by the solar irradiation.
30. The method according to any one of claims 27 to 29, wherein the object comprises silicon.
31. The method according to claim 30, wherein the object comprises a photovoltaic module comprising a plurality of silicon photovoltaic cells.
32. The method according to claim 30 or claim 31, wherein the spectral band has a centre wavelength in the range 1122 to 1130 nm or in the range 1134 to 1136 nm.
33. The method according to any one of claims 30 to 32, wherein the spectral band has a FWHM bandwidth of 3.0 nm or less.
34. The method according to claim 33, wherein the spectral band has a FWHM bandwidth of 2.0 nm or less.
35. The method according to claim 34, wherein the spectral band has a FWHM bandwidth of 1.0 nm or less.
36. The method according to claim 35, wherein the spectral band has a FWHM bandwidth of 0.6 nm or less.
37. The method according to any one of claims 27 to 29, wherein the spectral band has a centre wavelength in the range 1367 to 1372 nm, or in the range 1380 to 1383 nm, or in the range 1830 to 1880 nm.
38. The method according to any one of claims 27 to 37, wherein the spectral band is provided by a bandpass filter.
39. The method according to claim 38, wherein the temperature of the bandpass filter is maintained within a predetermined temperature range.

40. The method according to claim 38, wherein the temperature of the bandpass filter is controlled to tune the centre wavelength of the bandpass filter.
41. The method according to any one of claims 27 to 40, further comprising the step of interpreting the measured signal to obtain information on one or more properties of the object.
- 5 42. The method according to any one of claims 27 to 41, wherein the signal is measured with an image capture device.
43. An apparatus for measuring a photoluminescence response from an object exposed to solar irradiation, the apparatus comprising a measurement system for measuring a signal from an object exposed to solar irradiation, the signal being measured in a spectral band selected
10 such that at least 20% of the measured signal comprises photoluminescence generated from the object by the solar irradiation.
44. The apparatus according to claim 43, wherein the spectral band is selected such that at least 50% of the measured signal comprises photoluminescence generated from the object by the solar irradiation.
- 15 45. The apparatus according to claim 44, wherein the spectral band is selected such that at least 80% of the measured signal comprises photoluminescence generated from the object by the solar irradiation.
46. The apparatus according to any one of claims 43 to 45, wherein the apparatus is configured for measuring a photoluminescence response from an object comprising silicon.
- 20 47. The apparatus according to claim 46, wherein the apparatus is configured for measuring a photoluminescence response from an object comprising a photovoltaic module comprising a plurality of silicon photovoltaic cells.
48. The apparatus according to claim 46 or claim 47, wherein the spectral band has a centre wavelength in the range 1122 to 1130 nm or in the range 1134 to 1136 nm.
- 25 49. The apparatus according to any one of claims 46 to 48, wherein the spectral band has a FWHM bandwidth of 3.0 nm or less.
50. The apparatus according to claim 49, wherein the spectral band has a FWHM bandwidth of 2.0 nm or less.

51. The apparatus according to claim 50, wherein the spectral band has a FWHM bandwidth of 1.0 nm or less.
52. The apparatus according to claim 51, wherein the spectral band has a FWHM bandwidth of 0.6 nm or less.
- 5 53. The apparatus according to any one of claims 43 to 45, wherein the spectral band has a centre wavelength in the range 1367 to 1372 nm, or in the range 1380 to 1383 nm, or in the range 1830 to 1880 nm.
54. The apparatus according to any one of claims 43 to 53, wherein the measurement system comprises a bandpass filter for providing the spectral band.
- 10 55. The apparatus according to claim 54, wherein the measurement system comprises a temperature controller for maintaining the temperature of the bandpass filter within a predetermined temperature range, or for tuning the centre wavelength of the bandpass filter.
56. The apparatus according to any one of claims 43 to 55, further comprising a computer for interpreting the measured signal to obtain information on one or more properties of the
- 15 object.
57. The apparatus according to any one of claims 43 to 56, wherein the measurement system comprises an image capture device.
58. A method for measuring a photoluminescence response from a silicon sample, the method comprising the steps of:
- 20 (i) exposing the silicon sample to solar irradiation to generate photoluminescence from the silicon sample; and
- (ii) measuring a signal from the silicon sample in a spectral band having a centre wavelength in the range 1134.0 to 1136.0 nm and a FWHM bandwidth of 3.0 nm or less.
59. The method according to claim 58, wherein the spectral band has a FWHM bandwidth
- 25 of 2.0 nm or less.
60. The method according to claim 59, wherein the spectral band has a FWHM bandwidth of 1.0 nm or less.
61. The method according to claim 60, wherein the spectral band has a FWHM bandwidth of 0.6 nm or less.

62. An apparatus for measuring a photoluminescence response from a silicon sample exposed to solar irradiation, the apparatus comprising a measurement system configured to measure, from a silicon sample exposed to solar irradiation, a signal in a spectral band having a centre wavelength in the range 1134.0 to 1136.0 nm and a FWHM bandwidth of 3.0 nm or less.
- 5 63. The apparatus according to claim 62, wherein the spectral band has a FWHM bandwidth of 2.0 nm or less.
64. The apparatus according to claim 63, wherein the spectral band has a FWHM bandwidth of 1.0 nm or less.
65. The method according to claim 64, wherein the spectral band has a FWHM bandwidth
10 of 0.6 nm or less.
66. An article of manufacture comprising a non-transitory computer usable medium having a computer readable program code configured to implement the method according to any one of claims 1 to 13, or to operate the apparatus according to any one of claims 14 to 26.