

TITLE OF INVENTION: DEVICE AND METHOD TO DETERMINE SHEET RESISTANCE

The present invention relates to a device and a method to determine sheet resistance. More specifically, the subject matter of the present invention is a device and a method for determining the sheet resistance of a layer separated by a space charge region based on a photovoltage measurement.

In industrial environments, direct contact techniques and non-contact techniques are used to determine the sheet resistance of thin conductive or semiconductive layers. The so-called four-point sheet resistance measurement technique requiring direct contact is highly accurate but relatively slow and destructive. Hence, for in-line integrated sheet resistance measurements, where scanning of each sample is aimed, non-contact techniques are preferred. However, non-contact techniques have lower accuracy which is not sufficient for all applications.

In industry, there is a growing demand for instruments and processes that enable high accuracy and rapid non-contact measurement, as they can greatly reduce the proportion of waste products by both filtering out and removing defective feedstock from the manufacturing process and by quickly detecting and eliminating technical problems in the manufacturing process. Some of the non-contact techniques, namely methods based on eddy current generation and measurement, as well as methods based on infrared reflectance, are essentially capable of measuring the combined resistance of the entire layer structure. On the other hand, methods based on measuring the propagation of the electrical voltage generated by illumination of a p-n junction, i.e. the so-called „junction photovoltage”, JPV, parallel to the layers, that is laterally, are capable of measuring the resistance of the top conductive layer (called emitter layer) completely independently of those of the bottom conductive and semiconductive layers, because they are separated by an electrically insulating space charge region.

US Patent No. 5,442,297 discloses a method based on the measurement of the JPV for determining the sheet resistance. According to the solution described in this patent, the sample is illuminated by a light source in a small spot of light and the electric potential that changes due to the effect of charge carriers, i.e. electron-hole pairs, generated by said illumination around the illuminated spot is measured relative to the ground potential by means of ring-shaped electric potential sensors arranged concentrically around the illumination site. From the differing electric potentials measured by the sensors located at different distances from the illumination site, the sheet resistance of one or more upper layers of the sample which are electrically insulated from one or more layers below, for example by a space charge region, can be determined in the volume

portion between the sensors. A major drawback of this solution is the relative lack of localisation, i.e. the electric potentials are measured in annular regions below the sensors and thus the electric potential difference is also present in a region of space enclosed by the two sensor rings, so that the location of the discrepancies or material defects detected by measurement can be determined with relatively low accuracy. A further disadvantage of this solution is that, due to the relatively large size of the electric potential sensors, in a high-speed, continuous production line, the vibrations caused by the high running speed of the sample will cause some parts of said sensors to get closer to the sample than others. Thus, the sensors measuring accuracy reduces significantly. For samples transmitted at high speeds, static electrical charging of said samples and the fluctuations in ground potential due to static charges introduced into the grounding from static-charged machines also significantly degrade measurement accuracy.

A further method based on the measurement of JPV to determine sheet resistance is described in US Patent No. 9,921,261. Here, the illumination site is only half surrounded by the semicircular electrodes of the electric potential sensors. This solution allows better resolution than the use of full annular rings of the same radius, but due to the asymmetric sensor arrangement, the sheet resistance measured on the same surface element of a sample can be different depending on the orientation of the sensor, i.e. the measurement is highly anisotropic. This is disadvantageous for the evaluation of the measurement results and the detection of possible surface defects. Moreover, the calibration of the measuring device requires more samples prepared specifically for this purpose and a more complex function to be used to evaluate the measurement results, which results in more sources of inaccuracies, i.e. ultimately decreasing the accuracy and reliability of the measurement.

JPV-type non-contact sheet resistance sensors are used, among others, integrated in solar cell production lines. In recent years, the speed of production lines has increased significantly, which has increased the vibration of the samples running on the conveyor, as well as the electrical noise due to friction. As a consequence, the existing measuring heads have become unreliable.

In light of the above, the present invention aims at mitigating and/or eliminating the drawbacks of known solutions, in particular by providing a device and method based on a differential JPV method suitable for determining the sheet resistance of a layer separated by a space charge region, in particular an indium tin oxide layer, a zinc oxide layer, other transparent conductive layers, or a polysilicon layer in a tunnel current contact cell, with high accuracy, high speed and high resolution in at least one direction.

The objective to create the above mentioned device has been achieved by a device according to claim 1. Possible preferred exemplary embodiments of the device according to the invention are

set forth in claims 2 to 10. The objective to develop a method according to the invention is achieved by working out the method according to claim 11, the possible preferred exemplary embodiments of which are defined in claims 12 to 24.

The invention is based, in part, on the finding that the accuracy of a sheet resistance measurement can be significantly improved by eliminating measurement noise due to fluctuations in ground potential by forming the difference between electric signals from two electric potential sensors, especially in an analogous manner before amplifying said electric signals, and determining the sheet resistance from the difference signal.

The invention is further based on the finding that the resolution of a sheet resistance measurement can be increased and at the same time the error of the sheet resistance measurement due to vibration can be reduced by arranging the electric potential sensors and the excitation light source in such a way that two electric potential sensors of the same shape and size are arranged substantially in line with the illumination position of the light source.

The invention is based on a yet further finding that the accuracy of a sheet resistance measurement can be further improved by arranging two light sources in the measurement arrangement described above in line with the electric potential sensors, on opposite sides of the sensors.

The invention is further based on a surprising observation that by using two light sources and two electric potential sensors in a line, and switching the light sources alternately at appropriate frequencies, the difference signal of the electric potential sensors, for example in case of transparent conducting oxide (TCO) and polysilicon layers, shows a perfect direct proportionality with the sheet resistance of the layer to be measured over a range of sheet resistances, so that the measurement can be calibrated with high accuracy even using a sample from the production process itself - in contrast to prior art solutions that require a specifically prepared sample for the calibration.

The invention is further based on a finding that the accuracy of a sheet resistance measurement can be further improved by reducing the effect of sample vibration on the measurement results by continuously measuring the distance of the electric potential sensors relative to the sample surface and using the measured distance:

- a) to compensate for the measured result, in knowledge of the dependence of the measured electric potential on the actual distance between the electric potential sensor and the sample surface; or

(b) to maintain the distance between the electric potential sensor and the sample within a specified margin of error by displacing the sample and the measuring head containing the electric potential sensors relative to each other.

The solution according to the invention is described in detail below with reference to the accompanying drawing, wherein

- Figure 1 schematically illustrates a preferred exemplary embodiment of a device according to the invention;

- Figures 2a to 2c show a bottom view of the preferred exemplary arrangement of electric potential sensors and light sources in the device according to the invention; and

- Figure 3 is a block diagram of a preferred variant of the method according to the invention.

Figure 1 schematically illustrates a preferred exemplary embodiment of a device according to the invention. The device according to the invention comprises at least one light source 2 for illuminating a sample S. In the embodiment shown in the figure, the light source 2 comprises a secondary light source, which is, for example, a mirror, a lens or an optical fibre, preferably a glass rod. In such a case, the light source 2 is illuminated by a primary light source 1, preferably a device capable of emitting light in a relatively narrow spectral range and being preferably compact. The primary light source 1 is preferably a light emitting diode (LED) or a laser, but the device according to the invention may also be implemented with other primary light sources 1, such as a halogen lamp or an incandescent lamp and by applying suitable spectral filters. Alternatively, the light source 2 is constituted by a primary light source 1 whose light falls directly on the sample S - in this case, it is particularly advantageous to use a compact light source, e.g. a LED, as the primary light source 1. The device preferably further comprises means for continuously measuring and controlling the luminous intensity of the primary light source 1, e.g. a LED. The arrangement of such means is easier if the primary light source 1 is not directly illuminating the sample S but positioned at a distance from it and its light is transmitted to the sample S by the light source 2.

Intensity of the light transmitted to the sample is periodically varied at a modulation frequency. This can be achieved either by an appropriate regulation of the primary light source 1 and/or by means of a suitable optical device, such as an electro-optical device or an optical chopper, arranged between the primary light source 1 and the sample S. In a particularly preferred embodiment, the primary light source 1 comprises a light-emitting diode, i.e. LED, driven by an electrical signal, preferably a sinusoidal or a square wave signal, particularly preferably a square wave, modulated at a frequency equal to the modulation frequency. Basically, the intensity of the

light signal emitted by the primary light source 1 varies according to the wave form of the driving electrical signal. If this light signal is already a sinusoidal or a square wave signal suitable for use, additional optical elements present in the light path, if any, are chosen in such a way that the light signal reaching the sample is still a sinusoidal or a square wave signal. The modulation frequency shall be chosen to fall into the range of 0.1 Hz and 500 kHz, depending on the sheet resistance of the layer of the sample S to be measured and the capacitance of the space charge region. For most samples, the modulation frequency is preferably 4 to 32 kHz, which allows fast measurements. However, we have also discovered that for some samples which get electrostatically charged during certain steps of the manufacturing process, measurements in the 4 to 32 kHz frequency range provide incomprehensible results. To overcome this, in a further preferred embodiment, a modulation frequency below 500 Hz is used.

Depending on the intended use, the device according to the light source 2 used in the invention operates at a wavelength of 400 to 900 nm, preferably 600 to 900 nm. The optimum wavelength depends on the material, the purpose and the manufacturing technology of the sample S to be measured, as well as on the step in the manufacturing process after which the device is used for measurement, i.e. when the thickness of the layer is to be inspected. However, finding the ideal wavelengths is not an obvious task for a skilled artisan, because contrary to what is expected, the complexity of the layer structures and the variations in composition within the sample (the material composition of the individual layers, especially the amount of doping, as well as the thickness of the individual layers can equally vary within the same sample) often prevent analytical methods from finding a solution that describes the behaviour of the sample well, and results obtained from numerical simulations do not fully match the real behaviour of the samples.

Our measurements performed has led to the surprising conclusion, i.e. different from the results of the preliminary calculations, that the wavelength of the light source 2, or of the primary light source 1, is preferably 470 nm in sensors for the inspection of solar cell structures during manufacturing, while in general-purpose devices it is preferably green light, more preferably 520 nm. For the production of solar cells having newer, higher efficiency, so-called "tunnel oxide passivated contact" (TOPCon) layers and thin amorphous silicon passivation layers used in heterojunction technology (HJT), longer wavelengths, above 600 nm, and even in the near infrared range, are preferred. Wavelengths longer than 600 nm are also advantageous for testing passivated emitter and rear cell (PERC) solar cell structures, which still dominate the market, when layer thickness control is required prior to etching the temporarily applied phosphosilicate glass (PSG) or borosilicate glass (BSG) layer. Accordingly, in a particularly preferred embodiment, the primary light

source 1 comprises a light emitting diode operable at wavelengths of 470 nm, 520 nm, 600 to 700 nm, or 750 to 900 nm.

The light source 2 is used to illuminate the sample S in a single spot. At least two electric potential sensors 3 arranged near the spot measure the light-induced voltage at least at two different distances from the illuminated spot. Preferably, the at least one light source 2 and the at least two electric potential sensors 3 are arranged such that the illuminated spot and the orthogonal projection of the sensing surface of the electric potential sensors 3 onto the surface of the sample are aligned, i.e. the centres of their plane figures are on the same line. The sensing surfaces of the at least two electric potential sensors 3 are preferably of the same shape and size. In particular, the number of electric potential sensors 3 is most preferably two. The shape of the sensing surfaces of the 3 electric potential sensors is preferably circular, rhombic, or rectangular, more preferably rectangular. In a further particularly preferred embodiment, the rectangular sensing surfaces together with the area between them cover an approximately square area, for example in such a way that the rectangular sensing surfaces have an aspect ratio of about 1:2, the longer sides of said rectangles face each other and towards the light source 2, and the distance between the rectangles is less than the length of the shorter sides of said rectangles. An advantage of this arrangement is that the sheet resistance along the surface of the sample S can be measured in an essentially isotropic manner. The spot illuminated by the light source 2 on the sample S is preferably not farther from the edge of an orthogonal projection of the rectangular sensing surface of the electric potential sensors 3 on the sample surface than the length of the shorter side of said rectangle. This provides a relatively large difference between the signals measured by the electric potential sensors 3.

The at least two electric potential sensors 3 are connected to an amplifier 4, preferably a differential amplifier, which is configured to generate a differential signal of the at least two electric potential sensors 3 and to amplify it.

In a particularly preferred embodiment of the device illustrated in Figure 1, a chopped light signal is produced by the at least one light source 2, preferably by driving the primary light source 1 of the light sources 2 with a chopped electrical signal that is generated by a frequency generator 7. The chopped light signal can of course also be generated by a continuous light source and an optical chopper or a suitable electro-optical element. When a chopped light signal is used, the amplified difference signal produced by the amplifier 4 is pre-processed by a lock-in analyser 5 in signal transmission connection with said amplifier 4, wherein the lock-in analyser 5 is in data transmission connection with a processing unit 6 and, optionally, with the frequency generator 7. Application of the lock-in technique results in a much better signal-to-noise ratio in comparison with the case

where it is not applied, i.e. the measurement accuracy is significantly improved. Optionally, further electronic means for pre-amplification and/or pre-filtering can also be arranged between the electric potential sensor 3 and the amplifier 4. The processing unit 6 determines the sheet resistance from the measurement result and performs a further operation based on the measurement result, for example, saves it to a database or instructs a suitable further device to mark and/or move the sample. The processing unit 6 can be, for example, a simple desktop computer that, optionally, is capable of receiving, digitizing and buffering signals by means of a unit specifically tailored to this task. Preferably, the processing unit 6 is operatively connected to the frequency generator 7 and the primary light source 1, so that the operation of the latter can be controlled by the processing unit 6.

In a preferred embodiment, the lock-in analyzer 5 is connected to the frequency generator 7, whereby the frequency generator 7 provides a reference signal to the lock-in analyzer 5 for inspecting the signal from the differential amplifier 4. Alternatively, the lock-in analyzer 5 can be equipped with an internal clock signal generator, the frequency of which can be set to or equal to the modulation frequency of the light.

The processing unit 6 is further connected to an actuator 8 capable of displacing at least one of the sample S and/or the measuring head containing the electric potential sensors 3 closer to or farther away from the other. The actuator 8 is preferably provided by a motorized stage that holds the sample S, as well as moves and maintains the sample S at a distance suitable for performing the measurement.

In a further preferred embodiment, the device according to the invention comprises distance measuring means (not shown in the figures) adapted to measure the distance between the sample S and the electric potential sensors 3. The distance measuring means is either capacitive or optical in nature and can be integrated in the measuring head or it can form a separate external unit. The measured distance value can be used to correct the measured electric potential values, correct the sheet resistance value determined from the electric potential values and/or control the actuator 8 such that the distance between the sample S and the electric potential sensors 3 remains a constant value within a predetermined error margin. Both said correction and an active control of the distance significantly increase the accuracy and reliability of the sheet resistance measurement.

In a further advantageous embodiment, the device according to the invention also comprises means for measuring the surface reflectance of the sample S, which is preferably in data transmission connection with the processing unit 6. Thus, the result of a reflectance measurement carried out can be used to correct the value of the sheet resistance when it is calculated.

Figures 2a to 2c illustrate some particularly advantageous arrangements of the electric potential sensors 3 and light sources 2 arranged in the measuring head, as seen from the sample direction, i.e. from below, in a usual arrangement of the measuring head and the sample with the sample being below and the measuring head above. At the same time, Figures 2a to 2c basically correspond to the orthogonal projections of the sensing surfaces of the electric potential sensors 3 over the surface of said sample S and the light spots illuminated by the light sources 2. In each embodiment shown in Figs. 2a to 2c, i.e. when the light sources 2 and the electric potential sensors 3 are arranged in a line, the sensing surface of each of the electric potential sensors 3 are preferably planar plates which are symmetrical to both the axis that connects the light sources 2 and an axis perpendicular to the axis connecting the light sources 2, i.e. symmetrical to the axes indicated by dashed lines parallel to the X and Y directions shown in the Figures. Symmetry of the sensing surfaces with respect to the X-axis ensures that the upper and lower parts of the electric potential sensor 3 as shown in the Figures provide the same resolution and enable measurements with the same signal-to-noise ratio. Symmetry of the sensing surfaces with respect to the Y-axis ensures that the electric potential sensors 3 detect an electric potential due to the illumination by the light sources 2 on opposite sides of the electric potential sensors 3 with similar resolution and signal-to-noise ratio. The device according to the invention can also be implemented with a symmetry only along the X-axis or the Y-axis, or completely asymmetrically, but then the calibration of the device and the evaluation of the measurement results will be significantly more complex. In a particularly preferred embodiment of the device according to the invention, the at least one light source 2 and the electric potential sensors 3 are arranged relative to each other such that the centres of their orthogonal projections on the surface of the sample S are located centally symmetrically with respect to a centre C.

Each of the electric potential sensors 3 measures an average electric potential over the area covered by its sensing surface. Accordingly, a smaller sensor area allows for a measurement with higher resolution, but a smaller sensor area causes higher stochastic noise in the measurement. The electric potential difference measured by the electric potential sensors 3 is proportional to the sheet resistance along the X direction of the area covered by the electric potential sensors 3 and located between the electric potential sensors 3. Thus, it is particularly advantageous to select the size of the electric potential sensors 3 to be relatively small but not too small, and to choose their shape and spacing such that the area covered by said electric potential sensors 3 is approximately square, or at least the aspect ratio of said area is not too large. In this way, high resolution and relative isotropy of the sheet resistance measurement can be achieved.

Figure 3 is a block diagram of the method to determine the sheet resistance according to the invention. In the method, a sample S to be measured is illuminated 510 in at least one spot, the electric potential due to the illumination is measured 520 at least at two locations in the vicinity of the illuminated spot, then the difference of said electric potentials is produced and said difference is amplified 530, and then the sheet resistance is calculated 540 from the measured electric potentials using a predetermined function. Preferably, the predetermined function is a calibration function determined on the basis of electric potential measurements obtained by the inventive method using the measuring device according to the invention on samples with different known layer resistivities and the known layer resistivities themselves. Compared to the state-of-the-art techniques, a more accurate determination of the sheet resistance can be achieved by forming the difference of the analogue signals of the measured electric potentials, amplifying the analogue difference signal, and digitizing said difference only subsequently for the processing.

The steps of illuminating 510 and electric potential measuring 520 are preferably performed in a relatively small neighborhood of three points on the same line, thus achieving a higher resolution compared to the state-of-the-art techniques.

In a particularly preferred embodiment, the step of illuminating 510 is performed in the neighbourhood of two points, i.e. on two spots, and preferably the step of electric potential measuring 520 is performed at locations between the two illuminated spots, preferably while alternately illuminating said spots. Performing the measurement in this way allows, by averaging the signals recorded during the illumination by the two different light sources and analysing them accordingly, the elimination of certain types of defects present in the sample away from the measurement location and, for example, artifacts caused by an edge of the sample, such as an electrical signal reflected from the edge of a silicon wafer forming the sample. That is, in this way, the measurement accuracy can be further increased. The mode of performing the step of illuminating 510 described above, i.e. with the same frequency and with opposite phase, provides only a particularly advantageous and convenient variant of the method to compensate for such errors - alternatively or combined with it, it is also possible to use different wavelengths, intensities, illumination spot sizes, modulation frequencies or signal shapes at the two illumination points.

In a further preferred embodiment of the method according to the invention, the distance between the sample S and the electric potential sensors 3 is measured and the thus measured distance is preferably used, in determining the sheet resistance, to correct the measured electric potential value or to correct the sheet resistance value determined from the electric potential and/or to actively control the distance between the sample S and the electric potential sensors 3, by

moving the sample S and/or the electric potential sensors 3 based on the measured distance in such a way that said distance remains within a predetermined range. Both the correction discussed here and the active distance control significantly increase the accuracy and reliability of the sheet resistance measurement.

In a further preferred embodiment of the method according to the invention, the surface reflectance of the sample S is measured during the method and is used to correct the result when the step of calculating 540 the sheet resistance is performed.

In the method according to the invention, the step of illuminating 510 is preferably performed at a wavelength of 600 to 900 nm.

In a particularly preferred embodiment of the method according to the invention, the sheet resistance of a transparent conductive layer, in particular, an indium tin oxide layer, or a zinc oxide layer is determined, wherein the step of illuminating 510 is preferably performed at a wavelength of 600 to 700 nm.

In a particularly preferred embodiment of the method according to the invention, the sheet resistance of a polysilicon layer in a tunnel oxide passivated contact (TOPCon) is determined, wherein the step of illuminating 510 is preferably performed at a wavelength of 750 to 900 nm.

The above-described invention thus provides a non-contact device and method for measuring the sheet resistance of various samples, in particular, of feedstocks used in the manufacture of semiconductor products, and of thin layers of semi-finished or finished products made of said feedstocks with high accuracy, high speed and high resolution, and if necessary isotropically. Detecting material defects at an earlier stage of the manufacturing process by the solution according to the present invention allows the removal of defective feedstocks or semi-finished products from the manufacturing process and/or the rapid detection of possible anomalies in the manufacturing process. In this way, the proportion of the defective finished products is reduced, thus, ultimately, the cost of producing finished products is reduced and, at the same time, the amount of waste produced in the manufacturing process is also decreased, which is also environmentally beneficial.

Reference signs:

- S sample
- 1 primary light source
- 2 light source
- 3 electric potential sensor

4 amplifier

5 lock-in analyser

6 processing unit

7 frequency generator

8 actuator

510 step of illuminating

520 step of electric potential measuring

530 step of amplifying

540 step of calculating the sheet resistance

CLAIMS

1. A device for determining sheet resistance of a sample (S), comprising
 - a measuring head comprising
 - at least one light source (2) configured to transmit light to a surface of the sample (S),
 - and
 - at least two electric potential sensors (3),
 - an amplifier (4) arranged in signal transmission connection with the at least two electric potential sensors (3),
 - a processing unit (6) arranged in data communication connection with the amplifier (4) and configured to determine the sheet resistance from a difference signal of the at least two electric potential sensors (3),

characterized in that the amplifier (4) is configured to generate the difference signal of the at least two electric potential sensors (3) and to amplify the difference signal.
2. The device according to claim 1, **characterized in that** the at least two electric potential sensors (3) and the at least one light source (2) are arranged in such a way that the centre of the at least one light spot illuminated by the at least one light source (2) on the sample (S) and the centres of the orthogonal projections of the sensing surfaces of the electric potential sensors (3) on the surface of the sample (S) are aligned with each other.
3. The device according to claim 1, **characterized in that** the at least two electric potential sensors (3) and the at least one light source (2) are arranged in such a way that the at least one light spot illuminated by the at least one light source (2) on the sample (S) and the centres of the orthogonal projections of the sensing surfaces of the electric potential sensors (3) on the surface of the sample (S) are aligned with each other and are centred symmetrically with respect to a centre (C).
4. The device according to any one of claims 1 to 3, **characterized in that** the device comprises two light sources (2).
5. The device according to claim 4, **characterized in that** the at least two electric potential sensors (3) are arranged between the two light sources (2).
6. The device according to any one of claims 4 to 5, **characterized in that** the two light sources (2) are configured to operate at different wavelengths, intensities, illuminated spot sizes, driving frequencies, signal waveforms or phases.

7. The device according to any one of claims 1 to 6, **characterized in that** the device further comprises distance measuring means arranged in data communication connection with the processing unit (6).

8. The device according to claim 7, **characterized in that** the device further comprises an actuator (8) means (8) in data communication connection with the processing unit (6) and/or the distance measuring means, said actuator (8) being configured to move at least one of the electric potential sensors (3) and the sample (S) in a direction towards the other.

9. The device according to any one of the preceding claims, **characterized in that** the device further comprises reflectance measuring means for measuring surface reflectance, said means being arranged in data communication connection with the processing unit (6).

10. The device according to any one of the preceding claims, **characterized in that** the at least one light source (2) is configured to emit light of wavelengths between 600 nm and 900 nm.

11. A method to determine sheet resistance of a sample (S), wherein
 the sample (S) to be inspected is illuminated (510) in at least one spot,
 an electric potential due to the illumination is measured (520) in the vicinity of the illuminated spot by at least two electric potential sensors (3) at least at two locations,
 using a predefined function, the sheet resistance is calculated (540) from the measured electric potentials,
characterized in that
 before determining the sheet resistance, a difference of said electric potentials is determined and amplified (530).

12. The method according to claim 11, **characterized in that** the step of illuminating (510) and the step of electric potential measuring (520) are performed in the vicinity of three points being on the same line.

13. The method according to claim 11 or 12, **characterized in that** the sample (S) is illuminated in two spots.

14. The method according to claim 13, **characterized in that** the step of illuminating (510) and the step of electric potential measuring (520) are performed in the vicinity of four points being on the same line.

15. The method according to claim 14, **characterized in that** the step of illuminating (510) is performed in two spots which are outside of a section defined by two points that define the location of said electric potential measurement.
16. The method according to claim 14 or 15, **characterized in that** the step of illuminating (510) is performed in the two spots at different wavelengths, intensities, illuminated spot sizes, driving frequencies, signal shapes or phases.
17. The method according to claim 15 or 16, **characterized in that** the method further comprises a step of measuring a distance between the sample (S) and the electric potential sensors (3), and moving the sample (S) and/or the electric potential sensors (3) by means of an actuator (8) on the basis of the measured distance in such a way that said distance is within a predetermined range and/or said distance is used to correct the obtained result of the step of calculating (540) the sheet resistance.
18. The method according to any one of claims 11 to 17, **characterized in that** the method further comprises a step of measuring the surface reflectance of the sample (S), the surface reflectance obtained is used to correct the result of the step of calculating (540) the sheet resistance.
19. The method according to any one of claims 11 to 18, **characterized in that** in the step of illuminating (510), light having a wavelength of 600 nm to 900 nm is used.
20. The method according to any one of claims 11 to 19, **characterized in that** the method further comprises determining the sheet resistance of a transparent conductive layer.
21. The method according to claim 20, **characterized in that** the method further comprises determining the sheet resistance of an indium tin oxide layer or a zinc oxide layer.
22. The method according to claim 21, **characterized in that** the step of illuminating (510) is performed at a wavelength in a range of 600 to 700 nm.
23. The method according to any one of claims 11 to 19, **characterized in that** the method further comprises determining the sheet resistance of a polysilicon layer in a passivated tunnel current contact cell.
24. The method according to claim 23, **characterized in that** the step of illuminating (510) is performed at a wavelength in a range of 750 to 900 nm.