Claims

~~1. A system capable of transcutaneous measurement of a subject, wherein the system~~ comprises:

(a) at least one light source for shining light onto or through the skin of the subject; and

(b) at least one light detector for receiving light reflected from the tissues of the subject's skin or from the tissues underlying the subject's skin and converting the reflected light into a detected signal; and

(c) at least one component for generating or storing at least one value of VCO_2 or at least one value of VO_2 from the detected signal.

2. The system of claim **1**, wherein the at least one light source comprises a plurality of light sources that simultaneously or sequentially direct light of different wavelengths onto or through the skin of the subject.

3. The system of claim **1**, wherein the at least one light detector comprises a plurality of light detectors, each of which receives light of at least one wavelength.

4. The system of claim **1**, wherein the system incorporates at least one operational amplifier or at least one microprocessor by means of which at least one digital potentiometer may be iteratively adjusted in order to obtain optimal amplification of the at least one detected signal.

5. The system of claim **1**, wherein the at least one component stores, executes, transmits or receives at least one mathematical function or at least one parameter of the at least one mathematical function for generating at least one value of at least one parameter of physiology for the purpose of further mathematical calculation or for informing the subject of its physiological status.

6. The system of claim **5** wherein the at least one parameter of physiology may be selected from the group consisting of heart rate (HR), breathing rate (BR), hemoglobin concentration ([Hb]), oxyhemoglobin concentration ($[HbO_2]$), carbaminohemoglobin concentration ($[HbCO_2]$), oxygen saturation (SpO), oxygen consumption rate (VO_2), carbon dioxide production rate (VCO_2), Respiratory Exchange Ratio (RER), Respiratory Quotient (RQ), Food Quotient (FQ), Metabolic Fuel Composition (i.e. the macronutrient that a subject is utilizing as metabolic fuel at a given instance), Total Energy Expenditure (TEE), Resting Energy Expenditure (REE), Physical ~~Activity Energy Expenditure (PAEE), Energy Uptake (EU), Energy Balance (EB), Excess~~

Postexercise Oxygen Consumption (EPOC), Body Fat Percentage (%BF) and Current Body Composition (CBC).

7. The system of claim **1**, wherein the at least one component is further used for storing or transmitting or receiving data of pertinence to the at least one mathematical function by which the physiological status of a subject may be determined.

8. The system of claim **1**, wherein at least a second component stores, executes, transmits or receives at least one mathematical function or at least one parameter of the at least one mathematical function for generating at least one value of at least one parameter of physiology for the purpose of further mathematical calculation or for informing the subject of its physiological status.

9. The system of claim **8**, wherein the at least one parameter of physiology may be selected from the group consisting of heart rate (HR), breathing rate (BR), hemoglobin concentration ([Hb]), oxyhemoglobin concentration ($[HbO_2]$), carbaminohemoglobin concentration ($[HbCO_2]$), oxygen saturation (SpO), oxygen consumption rate (VO_2), carbon dioxide production rate (VCO_2), Respiratory Exchange Ratio (RER), Respiratory Quotient (RQ), Food Quotient (FQ), Metabolic Fuel Composition (i.e. the macronutrient that a subject is utilizing as metabolic fuel at a given instance), Total Energy Expenditure (TEE), Resting Energy Expenditure (REE), Physical Activity Energy Expenditure (PAEE), Energy Uptake (EU), Energy Balance (EB), Excess Postexercise Oxygen Consumption (EPOC), Body Fat Percentage (%BF) and Current Body Composition (CBC).

10. The system of claim **1**, wherein at least a second component is used for storing or transmitting or receiving data of pertinence to the at least one mathematical function by which the physiological status of a subject may be determined.

11. The system of claim **1**, further comprising at least one transmitter for transmitting the at least one value of VCO_2 or the at least one value of VO_2 to at least one other electronic device for storage, further mathematical processing, analysis, or for informing the subject of its physiological status.

12. The system of claim **1**, further comprising at least one receiver for receiving data from at least one other electronic device, where the data is of pertinence to the at least one mathematical function by which the physiological status of a subject may be determined.

13. The system of claim **1**, further comprising at least one power source for powering the system.

~~14. The system of claim 1, wherein at least one part of the system may be embodied in the~~ form of a wearable device.

15. The system of claim **14**, wherein the wearable device comprises a connector for positioning the wearable device on a subject's body, such that the at least one light source and the at least one light detector are positioned in close enough proximity to the subject's skin to allow the at least one light detector to receive light reflected from molecules inside, or in the tissues underlying the subject's skin or on the subject's skin.

16. The system of claim **14**, wherein the wearable device comprises a disposable or reusable patch that can be stuck directly onto the skin of the subject.

17. The system of claim **14**, wherein the wearable device is incorporated into textiles or other material worn in close proximity to the subject's body.

18. A method for transcutaneous measurement of a subject, wherein the method comprises the steps of:

(a) shining light onto or through the skin of the subject; and

(b) receiving light reflected from the tissues of the subject's skin or from the tissues underlying the subject's skin and converting the reflected light into a detected signal; and

(c) generating at least one value of VCO_2 or at least one value of VO_2 from the detected signal.

19. The method of claim **18**, wherein the generating step comprises storing, executing, transmitting or receiving at least one mathematical function or at least one parameter of the at least one mathematical function for generating at least one value of at least one parameter of physiology for the purpose of further mathematical calculation or for informing the subject of its physiological status.

20. The method of claim **18**, wherein the generating step stores or transmits or receives data of pertinence to the at least one mathematical function by which the physiological status of a subject may be determined.

21. The method of claim **18**, further comprising the step of storing, executing, transmitting or receiving at least one mathematical function or at least one parameter of the at least one mathematical function for generating at least one value of at least one parameter of physiology for the purpose of further mathematical calculation or for informing the subject of its ~~physiological status.~~

22. ~~The method of claim **18**, wherein the generating step is used for storing or transmitting~~ or receiving data of pertinence to the at least one mathematical function by which the physiological status of a subject may be determined.

23. The method of claim **18**, further comprising the step of transmitting the at least one value of VCO_2 or the at least one value of VO_2 to at least one other electronic device for storage, further mathematical processing, analysis, or for informing the subject of its physiological status.

24. The method of claim **18**, further comprising the step of receiving data from at least one other electronic device, where the data is of pertinence to the at least one mathematical function by which the physiological status of a subject may be determined.

25. A system adapted to provide an uninterrupted power supply to an electronic circuit when a first electrical cell has to be replaced with a second electrical cell, each of the electrical cells having at least one positive cell terminal and at least one negative cell terminal, and the socket system comprising a channel through which an electrical cell may be inserted, where:

(a) the inner surface of the channel contains at least one positive socket terminal and at least one negative socket terminal; and

(b) each of the at least one positive socket terminals and the at least one negative socket terminals are positioned on the inner surface of the channel such that when the first electrical cell is inserted into the channel, its at least one positive cell terminal makes contact with the at least one positive socket terminal and its at least one negative cell terminal makes contact with the at least one negative socket terminal; and

(c) the second electrical cell operates to push the first electrical cell out of the channel such that the at least one positive cell terminal of the first electrical cell remains in contact with the at least one positive socket terminal until the at least one positive cell terminal of the second electrical cell has come into contact with the at least one positive socket terminal and the at least one negative cell terminal of the first electrical cell remains in contact with the at least one negative socket terminal until the at least one negative cell terminal of the second electrical cell has come into contact with the at least one negative socket terminal, such that uninterrupted electrical connectivity is maintained to the electronic circuit.

26. ~~The system of claim **25**, wherein the first or second cell can be inserted into the channel~~

~~of the socket in any orientation and still make contact with the correct contact points inside the socket.~~

~~27.~~1. A portable device for analyzing the composition of the respired gasses of a subject, wherein the device comprises:

(a) a body adapted to be held in a hand of the subject; and

(b) at least one air flow conduit through which the subject can inspire or expire air through the body of the device; and

(c) a sample analysis chamber; and

(d) at least one sampling portal through which air may move into or out of the sample analysis chamber, favoring net inflow of expired air into the sample analysis chamber as a result of a diodicity generated by the design of the air flow conduit and sampling portal; and

(e) an oxygen sensor for measuring the oxygen concentration of the air inside the sample analysis chamber; and

(f) at least one flow sensor for measuring the flow of inspired or expired air through the device.

~~28.~~2. The device of claim ~~27~~1, further comprising an affixed connector for extending the air flow conduit beyond the outer perimeter of the device's body.

~~29.~~3. The device of claim ~~27~~1, further comprising a removable connector for extending the air flow conduit beyond the outer perimeter of the device's body.

~~30.~~4. The device of claim ~~27~~1, further comprising at least one purge portal through which the gas may move into or out of the sample analysis chamber.

~~31.~~5. The device of claim ~~30~~4, wherein a unidirectional valve is positioned across the opening of the purge portal, such that the fluid forces of an exhalation causes some of the exhaled air to enter the sample analysis chamber through the sampling portal, at the same time forcing some of the gasses inside of the sample analysis chamber to exit the chamber through the unidirectional valve.

~~32.~~6. The device of claim ~~30~~4, wherein a unidirectional sampling valve is positioned across the opening of the sampling portal and across the opening of the purge portal such that the fluid forces of an exhalation causes some of the exhaled air to enter the sample analysis chamber through the unidirectional sampling valve, at the same time forcing some of the gas inside of the sample analysis chamber to exit the chamber through the purge portal.

~~33.~~7. The device of claim ~~27~~1, wherein a unidirectional sampling valve is positioned across the opening of the sampling portal, such that the fluid forces of an exhalation causes some of the exhaled air to enter the sample analysis chamber through the unidirectional sampling valve.

~~34.~~8. The device of claim ~~27~~1, wherein the sampling portal is designed such that the fluid forces of an exhalation causes some of the exhaled air to enter the sample analysis chamber through the sampling portal without the need for a unidirectional valve.

~~35.~~9. The device of claim ~~27~~1, further comprising at least one active sampling mechanism for diverting exhaled air from the air flow conduit into the sample analysis chamber during or right after an exhalation.

~~36.~~10. The device of claim ~~35~~9, wherein the at least one active sampling mechanism may be selected from the group comprising at least one controllable valve, at least one controllable sampling pump, at least one controllable vacuum pump, and at least one plunger that could cause a negative pressure inside the sample analysis chamber.

~~37.~~11. The device of claim ~~27~~1, further comprising a fan or a pump for forcing fresh air into the sample analysis chamber or the air flow conduit, thereby pushing the accumulated sampled gasses, vapors or condensates out of the sample analysis chamber.

~~38.~~12. The device of claim ~~27~~1, further comprising a fan or a pump for forcing the accumulated sampled gasses, vapors or condensates out of the sample analysis chamber, thus allowing fresh air to enter the sample analysis chamber.

~~39.~~13. The device of claim ~~27~~1, further comprising a flap or disk that can be opened for allowing fresh air to move into the sample analysis chamber or air flow conduit, while the accumulated sampled gas, vapors or condensates dissipate from the sample analysis chamber.

~~40.~~14. The device of claim ~~27~~1, further comprising a CO_2 sensor for measuring the carbon dioxide (CO_2) concentration of the air inside the sample analysis chamber.

~~41.~~15. The device of claim ~~40~~14, wherein the CO_2 sensor makes use of at least one principle selected from the group consisting of electrochemistry, spectrophotometry, colorimetry, and chemistry.

~~42.~~16. The device of claim ~~27~~1, further comprising a temperature sensor for measuring the temperature of the air inside the sample analysis chamber.

~~43.~~17. The device of claim ~~27~~1, further comprising a humidity sensor for measuring the humidity of the air inside the sample analysis chamber.

~~44.~~18. The device of claim ~~27~~1, wherein the a oxygen sensor makes use of at least one principle selected from the group consisting of electrochemistry, spectrophotometry, colorimetry, and

chemistry.

~~45.~~19. The device of claim ~~27~~1, further comprising vapor scrubbers for sequestering water vapor from the expired gasses to ensure that the various sensors of the sample analysis chamber may operate under conditions of humidity conductive to their correct performance.

~~46.~~20. The device of claim ~~45~~19, wherein the vapor scrubbers may be positioned alongside the air flow conduit, across the air flow conduit, inside the removable connector, inside the sampling portal, or inside the sample analysis chamber.

~~47.~~21. The device of claim ~~27~~1, further comprising at least one component for storing or transforming at least one detected signal of at least one sensor into data useful for further processing.

~~48.~~22. The device of claim ~~27~~1, further comprising a component suitable for storing or executing or transmitting or receiving at least one mathematical function for generating at least one value of at least one parameter of physiology from the at least one detected sensor signal.

~~49.~~23. The device of claim ~~48~~22, wherein the at least one parameter of physiology may be selected from the group comprising oxygen content of the expired gasses, carbon dioxide content of the expired gasses, breathing rate, minute volume, $V0_2$, VCO_2, Respiratory Exchange Ratio, Respiratory Quotient, Body Fat Percentage, Current Body Composition, Heart Rate and Overtraining.

~~50.~~24. The device of claim ~~48~~22, further comprising at least one component suitable for storing the data generated by at least one mathematical function for subsequent retrieval or display.

~~51.~~25. The device of claim ~~48~~22, further comprising at least one component by which the at least one parameter of physiology may be transmitted to another device to be relayed to the subject.

~~52.~~26. The device of claim ~~27~~1, further comprising at least one light producing module and at least one light detecting module for measuring the cardiorespiratory profile of the subject to obtain information about the subject's heart rate, heart rate variability, pulse profile, left-right hand pulse profile comparison or breathing rate.

~~53.~~27. The device of claim ~~27~~1, further comprising at least two surface electrodes for measuring the bioelectrical impedance of a subject for calculating its body composition.

~~54.~~28. The device of claim ~~27~~1, further comprising a power source for providing power to the components of the device.

~~55.~~29. The device of claim ~~27~~1, further comprising at least one component for detecting the moment at which the detected signal from at least one of the sensors in the system has

stabilized sufficiently to warrant that the data generated by the at least one sensor will be suitable for accurate estimation of the at least one parameter of physiology of the subject.

~~56.~~30. The device of claim ~~27~~1, further comprising at least one component for detecting the moment at which the user's respiration cycle has stabilized to a point which indicates that the subject has reached a physiological state suitable for commencement or termination of gas analysis in the sample analysis chamber.

~~57.~~31. The device of claim ~~27~~1, wherein the design of the air flow conduit or sampling portal is such that air flowing through the air flow conduit as a result of an inhalation will pass by the sampling portal with only a negligible amount entering the sample analysis chamber, while air flowing through the air flow conduit as a result of an exhalation will be subject to forces that causes a portion of the expired air to move through the sampling portal and into the sample analysis chamber.

~~58.~~32. A method for analyzing the composition of respired gas of a subject, wherein the method comprises the steps of:

(a) providing at least one air flow conduit through which the subject can inspire or expire air through the body of the device;

(b) providing a sample analysis chamber positioned within the body;

(c) providing at least one sampling portal through which air may move into or out of the sample analysis chamber;

(d) providing an oxygen sensor for measuring the oxygen concentration of the air inside the sample analysis chamber; and

(e) providing at least one flow sensor for measuring the flow of inspired or expired air through the device.