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 for each ~~of VCO_2 or at least one value of VO_2~~ of VCO_2 and 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 the digital signal, at least one mathematical function ~~or~~ at least one parameter of the at least one mathematical function, or any combination thereof 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])~~(H_b), oxyhemoglobin concentration ~~([HbO_2])~~(HbO_2), carbaminohemoglobin concentration ~~([$HbCO_2$])~~($HbCO_2$), 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 the digital signal, at least one mathematical function, ~~or~~ at least one parameter of the at least one mathematical function, or any combination thereof 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])~~(H_b), oxyhemoglobin concentration ~~([HbO_2])~~(HbO_2), carbaminohemoglobin concentration ~~([$HbCO_2$])~~($HbCO_2$), 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 for each ~~of VCO_2 or at least one value of VO_2~~ of VCO_2 and VO_2 from the detected signal.

19. The method of claim **18**, wherein the generating step comprises storing, executing, transmitting or receiving the digital signal, at least one mathematical function, ~~or~~ at least one parameter of the at least one mathematical function, or any combination thereof 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 the digital signal, at least one mathematical function, ~~or~~ at least one parameter of the at least one mathematical function, or any combination thereof 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. The system of claim **1**, wherein VCO_2 corresponds to the instantaneous rate of carbon dioxide production by the subject's total aerobic metabolic activity.

26. The system of claim **25**, wherein VCO_2 is determined from resting and real-time heart rate data measured from the detected signal and at least one mathematical function describing cellular carbon dioxide production rate globally across the subject's whole body, the parameters of which are determined using a parameter estimation approach.

27. The system of claim **1**, wherein VO_2 corresponds to the instantaneous oxygen consumption rate by the subject's total aerobic metabolic activity.

28. The system of claim **27**, wherein VO_2 is determined from resting and real-time heart rate data measured from the detected signal and at least one mathematical function describing oxygen consumption rate globally across the subject's whole body, the parameters of which are determined using a parameter estimation approach.

29. The method of claim **18**, where VCO_2 corresponds to the instantaneous rate of carbon dioxide production by the subject's total aerobic metabolic activity.

30. The method of claim **29**, wherein VCO_2 is determined from resting and real-time heart rate data measured from the detected signal and at least one mathematical function describing cellular carbon dioxide production rate globally across the subject's whole body, the parameters of which are determined using a parameter estimation approach.

31. The method of claim **18**, wherein VO_2 corresponds to the instantaneous oxygen consumption rate by the subject's total aerobic metabolic activity.

32. The method of claim **31**, wherein VO_2 is determined from resting and real-time heart rate data measured from the detected signal and at least one mathematical

function describing oxygen consumption rate globally across the subject's whole body, the parameters of which are determined using a parameter estimation approach.

33. The system of claims **7** or **12**, wherein the data of pertinence may pertain to the at least one digital signal, at least one mathematical function, at least one parameter, at least one subject input or any combination thereof.

34. The method of claim **24**, wherein the data of pertinence may pertain to the at least one digital signal, at least one mathematical function, at least one parameter, at least one subject input or any combination thereof.