CLAIMS

1. An exposed electrode negative air ion device, the device comprising:

(a) an electronics module including an input port, a negative voltage generator, and an output port,

(i) wherein the input port is configured to electrically receive a power supply and electrically route the power supply to the negative voltage generator;

(ii) wherein the negative voltage generator is configured to:

(1) generate a negative voltage source from the power supply; and

(2) output the negative voltage source to the output port within a set of electrical parameters; and

(iii) wherein the set of electrical parameters includes:

(1) a maximum preset negative voltage of V_{MAX}; and

(2) a maximum operating current, the maximum operating current set below or equal to a direct current detection threshold; and

(b) an exposed electrode, the exposed electrode including a mat surface of intertwined individual fibres,

(i) wherein the mat surface of the exposed electrode is directly or indirectly electrically connected to the output port of the electronics module at one or more electrical connection points; and

(ii) wherein the mat surface has a minimum mean resistance of R_{MIN}, as measured during a discharge event between the output port of the electronics module and a measurement probe, the measurement probe tipped with a polished stainless steel sphere having a diameter of twenty millimetres, where:

$$R_{MIN} = \frac{V_{MAX}}{I_{TH}} \qquad \textit{(Equation 1); and}$$

I_{TH} is a capacitive current discharge detection threshold.

2. The device of claim 1, wherein the mat surface is flat in shape and has a maximum surface area of A_{MAX}, where:

$$A_{MAX} = \pi \times \left(\frac{Q_{TH}}{V_{MAX} \times 8\epsilon_0} \right)^2 \quad (Equation\ 3d);$$

Q_{TH} is a charge discharge detection threshold; and

ϵ_0 is permittivity of free space.

3. The device of claim 1, wherein the mat surface is spherical in shape and has a maximum radius of r_{MAX}, where:

$$r_{MAX} = \frac{Q_{TH}}{V_{MAX} \times 4\epsilon_0} \quad (Equation\ 4b);$$

Q_{TH} is a charge discharge detection threshold; and

ϵ_0 is permittivity of free space.

4. The device of claim 2 or 3, wherein the charge discharge detection threshold is 0.4 µC.

5. The device of claim 1, wherein the direct current detection threshold is 2.0 mA.

6. The device of claim 1, wherein the capacitive current discharge detection threshold is 2.0 mA.

7. The device of claim 1, wherein the minimum mean resistance of R_{MIN} is in the range of 10 MΩ to 40 MΩ.

8. The device of claim 1, wherein the intertwined individual fibres are comprised of at least one of coconut coir fibre, hyacinth fibre, jute fibre, abaca fibre, banana fibre, pineapple fibre, and nettle fibre.

9. The device of claim 1, wherein the intertwined individual fibres are comprised of flame retardant coconut coir fibres with:

(a) a mean diameter in the range of 0.1 mm to 0.5 mm; and

(b) a mean length in the range of 0.15 m to 0.28 m.

10. The device of claim 1, wherein the intertwined individual fibres are hygroscopic.

11. The device of claim 1, wherein the mat surface of the exposed electrode is at least one of:

(a) a length of intertwined individual fibres wrapped around a spherical base or a cylindrical base;

(b) a suspended rope; and

(c) a rectangular mat.

12. The device of claim 1, wherein the maximum preset negative voltage of V_{MAX} ranges from -18 kV to - 22 kV.

13. The device of claim 1, wherein the electronics module is incorporated into the exposed electrode.

14. The device of claim 1,

(a) wherein the exposed electrode includes a conductive base;

(b) wherein the mat surface of intertwined individual fibres is mounted on the conductive base; and

(c) wherein the conductive base is electrically connected to the output port of the electronics module at the one or more electrical connection points.

15. The device of claim 14,

(a) wherein the exposed electrode includes an insulative perimeter and an insulative surface; and

(b) wherein the conductive base is located between the mat surface and the insulative surface.

16. The device of claim 14, wherein the conductive base comprises a carbon infused elastomer.

17. A negative air ion panel system, comprising two or more of the device of any one of claims 1 to 16 mounted in an exposed environment.

18. The system of claim 17, wherein each of the mat surfaces of the devices in the system are configured in at least one of:

(a) a grid arrangement on a wall, a ceiling, or a floor of the exposed environment;

(b) a grouping of spheres or cylinders in the exposed environment; and

(c) a set of individual panel mountings in the exposed environment.

19. The system of claim 17, the system further comprising a power system for each of the devices, wherein the power supply is generated by a local solar panel.

20. The system of claim 17, the system further comprising a gateway, a network, and an offsite server, wherein each electronics module of the devices in the system further includes an IoT module in data communication with the offsite server through the gateway and the network.

21. The system of claim 20,

(a) wherein the offsite server further comprises a parameter settings module, the parameter settings module configured to store a latest set of electrical parameters for each device in the system;

(b) wherein the IoT module of each device is configured for wired or wireless data communication to and from the parameter settings module of the offsite server via the gateway and the network;

(c) wherein the parameter settings module is configured to send each device the latest set of electrical parameters for the device; and

(d) wherein each device is configured to receive the latest set of electrical parameters for the device, via the IoT module of the device, from the parameter settings module.

22. The system of claim 20,

(a) wherein the offsite server further comprises a sensor records module;

(b) wherein the system further comprises a plurality of sensors mounted in the exposed environment that are each in data communication with the sensor records module of the offsite server via the gateway and the network; and

(c) wherein the sensors include at least one of:

(i) a temperature sensor;

(ii) a humidity sensor;

(iii) a motion sensor; and

(iv) a negative ion concentration sensor.

23. The system of claim 20,

(a) wherein the offsite server further comprises an analytics module; and

(b) wherein the analytics module is configured to create a system report detailing at least one of:

(i) a history of selected sensor data stored in the sensor records module; and

(ii) a summary of the latest set of electrical parameters for each device in the system.