CLAIMS

1. A battery recyclability assessment method comprising:
identifying a volume variation of a battery-under-test;
upon the volume variation being determined not exceeding a predetermined volume variation threshold, identifying an external surface degradation of the battery-under-test, and
upon the external surface degradation being determined not exceeding a predetermined surface degradation threshold, obtaining electrical characteristics of the battery-under-test to determine a recyclability of the battery-under-test,
wherein identifying a volume variation of a battery-under-test comprises:
hermetically sealing the battery-under-test in a chamber;
filling the chamber with a volume of test air until an air pressure in the chamber reaching a predetermined level;
comparing the volume of test air with a volume of reference air corresponding to a reference battery, wherein the reference battery having a specification the same as the battery-under-test,
wherein the volume variation of the battery-under-test is determined by a difference between the volume of reference air and the volume of test air.

2. The method as recited in claim 1, further comprising, prior to comparing the volume of test air with a volume of reference air corresponding to a reference battery, establishing the volume of reference air corresponding to the reference battery.

3. The method as recited in claim 2, wherein establishing the volume of reference air corresponding to the reference battery comprises:
hermetically sealing the reference battery in the chamber;
filling the chamber with the volume of refence air until an air pressure in the chamber reaching the predetermined level.

4. The method as recited in claim 1, wherein the chamber has a first temperature when filled with the volume of reference air, the chamber has a second temperature when

filled with the volume of test air, wherein the second temperature is the same as the first temperature.

5. The method as recited in claim 1, wherein the battery-under-test is determined to be non-recyclable upon the volume variation of a battery-under-test exceeding the predetermined volume variation threshold.

6. The method as recited in claim 5, wherein identifying an external surface degradation of the battery-under-test comprises:

capturing an image of the external surface of the battery-under-test, and

identifying a surface defect of the battery-under-test from the image,

wherein the battery-under-test is determined to be non-recyclable upon the surface defect being identified to include a recessed portion and a raised portion.

7. The method as recited in claim 1, wherein identifying an external surface degradation of the battery-under-test comprises:

capturing an image of the external surface of the battery-under-test;

identifying a surface defect of the battery-under-test from the image, and

comparing the surface defect with a predetermined surface degradation threshold,

wherein the battery-under-test is determined to be non-recyclable upon the surface defect exceeding a predetermined surface degradation threshold.

8. The method as recited in claim 6, wherein the surface defect includes one of a scratch, a dent, and a bump on the external surface of the battery-under-test, the predetermined surface degradation threshold includes a predetermined dimension threshold, the battery-under-test is determined to be non-recyclable upon a physical dimension of the one of a scratch, a dent, and a bump exceeding the predetermined dimension threshold.

9. The method as recited in claim 6 or claim 7, wherein capturing an image of the external surface of the battery-under-test is implemented by an imaging device through a telecentric lens.

10. The method as recited in claim 1, wherein the electrical characteristics of the battery-under-test includes a state of charge, a health status and a remaining power of the battery-under test, wherein obtaining electrical characteristics of the battery-under-test comprises assessing the state of charge, the health status and the remaining power of the battery-under-test by a multimodal evaluation module, an electrochemical model module, an equivalent circuit model module and a neural network model module.

11. A battery recyclability assessment system comprising:

a first apparatus configured for identifying a volume variation of a battery-under-test according to a method as recited in any one of claims 1 to 5;

a second apparatus configured for identifying an external surface degradation of the battery-under-test according to a method as recited in any one of claims 1 and 6 to 9;

a third apparatus configured for obtaining electrical characteristics of the battery-under-test according to a method as recited in any one of claims 1 and 10, and

a data storage module in data communication with the first apparatus, the second apparatus and the third apparatus,

wherein the first apparatus comprises a hermetically sealable chamber for receiving a batter therein, an air supply device connected to the chamber for filling air into the chamber, and a measurement device coupled to the chamber for determining a volume, a temperature and a pressure of air filled into the chamber, and the measurement device is in data communication with the data storage module for transferring data related to the volume, the temperature and the pressure of air filled into the chamber with the data storage module.

12. The system as recited in claim 11, wherein the second apparatus comprises an imaging device and a telecentric lens coupled to the imaging device for capturing an image of a battery, and an image processor coupled to the imaging device for receiving and processing images captured by the imaging device, and the image processor being in data communication with the data storage device for transferring image data with the data storage device.

13. The system as recited in claim 11, further comprising a battery data acquisition module and an environment data acquisition module coupled to the data storage device for obtaining data from the battery-under-test and data from an environment within which the battery-under-test is disposed.

14. The system as recited in claim 11, further comprising an electrochemical model module, an equivalent circuit model module, a neural network model module and an electrothermal coupling model module coupled to the data storage module for assessing a state of charge, a health status and a remaining power of the battery-under test and transfer data of assessment result to the data storage module.

15. The system as recited in claim 11, further comprising a state of charge evaluation module, a battery health evaluation module and a battery remaining power module coupled to the data storage module for obtaining a state of charge, a health status and a remaining power of the battery-under-test and transferring corresponding data to the data storage module.

16. The system as recited in claim 11, wherein the data storage module further comprises a battery standard specification database, a modal database, an evaluation result database and system database coupled to the data storage module for transferring corresponding data to the data storage module.