CLAIMS

1. A method for diagnosing the operating state of an electrochemical system (1, 30) in real-time comprising a stack of cells, this method comprising steps for performing voltage measurements at the terminals of said cells, characterized in that it further comprises:
   - real-time processing of the voltage measurements thus performed, in order to extract specific waveforms (40) therefrom,
   - converting (62) said specific waveforms (40) in order to generate specific points (65) therefrom of the real-time operation of said electrochemical system (1, 30), and
   - comparing said specific points (65) of the real-time operation with specific points (75) of an off-line operation of said electrochemical system (1, 30) that originate from a conversion (73) of specific waveforms (74) extracted from voltage measurements (78) performed off-line, while said electrochemical system (1, 30) is placed in known operating states including fault states, so as to produce information (69) relating to the real-time operation of said electrochemical system (1, 30).

2. The method as claimed in claim 1, characterized in that the cell voltage measurement steps are performed periodically.

3. The method as claimed either in claim 1 or claim 2, characterized in that the specific waveforms (40, 74) extracted from the voltage measurements performed off-line and/or in real-time are subjected to a mathematical transformation (62, 73) - called “shapelet transform” - in order to create specific points (65, 75).

4. The method as claimed in claim 3, characterized in that the specific points are identified in a two-dimensional (2D) space, then classified in a three-dimensional (3D) space.

5. The method as claimed in claim 4, characterized in that the specific points are classified by means of a Sphere Shaped Multi-Class – Support Vector Machine (SSM-SVM) type function (63, 76).

6. The method as claimed in either claim 4, characterized in that the specific points are classified by means of a K Nearest Neighbor (kNN) type function.

7. The method as claimed in any one of claims 4 , characterized in that the specific points are classified by means of a Gaussian Mixture Model (GMM) type function.

8. The method as claimed in any one of the preceding claims, characterized in that it furthermore comprises an initial establishment of a database through learning (71) of the known operating states of the electrochemical system (1, 30) that are tested off-line.

9. The method as claimed in any one of the preceding claims, implemented in order to diagnose the operating state of a fuel cell (30), characterized in that the known operating states that are tested off-line comprise all or some of the following states: normal operation, low hydrogen pressure, low stoichiometry on the air side, drying, flooding, high pressure.

10. A system for diagnosing the operating state of an electrochemical system (1, 30) in real-time comprising a stack of cells, implementing the diagnostic method according to any one of the preceding claims, comprising means for measuring the voltage values at the terminals of said cells, characterized in that it further comprises:
    - means for processing the voltage values thus measured in order to extract specific waveforms therefrom,
    - means for converting said specific wave forms in order to generate specific points of the real-time operation of said electrochemical system therefrom, and
    - means for comparing said specific points of the real-time operation and specific points of an off-line operation of said electrochemical system that originate from a conversion of specific waveforms extracted from voltage measurements performed off-line, while said electrochemical system is placed in known operating states including fault states, so as to extract information relating to the real-time operating state of said electrochemical system.

11. The diagnostic system as claimed in claim 10, characterized in that it further comprises means for converting the specific waveforms extracted from the voltage measurements performed off-line and/or in real-time, so as to create specific points.

12. The diagnostic system as claimed in claim 10, characterized in that it further comprises means for identifying the specific points in a two-dimensional (2D) space and means for classifying said specific points thus identified in a three-dimensional (3D) space.

13. The diagnostic system as claimed in any one of claims 10 to 12, characterized in that it further comprises a database through learning of known operating states of said electrochemical system.

14. An electronic system including a stack of cells, incorporating a diagnostic system as claimed in ay one of claims 10 to 13.

15. The electronic system as claimed in claim 14, characterized in that it includes a fuel cell.