CLAIMS

1. A system for in-situ characterization of functional devices comprising:

a vacuum chamber;

a pump system coupled to the vacuum chamber for evacuation the vacuum chamber to near ultra high vacuum pressures of about 10^{-8} mbar or lower;

a sample holder for a functional device based on nanostructured materials disposed inside the vacuum chamber and configured to provide electrical connection to the functional device for measuring electrical properties of the functional device;

a source system for exposing a surface/interface of the functional device to a modification species;

whereby the system is configured to measure the electrical properties of the functional device in-situ upon the exposure to the modification species; and

an optical microscope system external to the vacuum chamber and configured to illuminate the surface/interface of the functional device when disposed on the sample holder in the vacuum chamber, whereby the system is configured to measure optoelectrical properties of the functional device in-situ upon the illumination.

2. The system of claim 1, wherein the vacuum chamber comprises a view port, and the microscope system is configured to illuminate the surface/interface of the functional device when disposed on the sample holder in the vacuum chamber through the view port.

3. The system of claims 1 or 2, wherein the sample holder is moveable to position the functional device in a fine focus position for the illumination of the surface/interface of the functional device.

4. The system of any one of claims 1 to 3, comprising a vibration reduction or elimination mechanism coupled to the vacuum chamber, the optical microscope system and the sample holder.

5. The system of any one of claims 1 to 4, wherein the source system comprises one or more of an evaporation cell for evaporating various materials inside the vacuum chamber and a gas-inlet for introducing various gases into the vacuum chamber.

6. The system of claim 5, wherein the evaporation cell is configured to direct the evaporated material towards the surface/interface of the functional device when the sample holder is in a deposition position.

7. The system of claim 6, wherein the evaporation cell is configured to direct the evaporated material towards the surface/interface of the functional device when the sample holder is in a deposition position at a non-zero angle relative to an optical axis of the microscope system.

8. The system of any one of claims 5 to 7, comprising an evaporation rate measurement mechanism disposed inside the vacuum chamber to monitor the evaporation rate of the evaporation cell.

9. The system of any one of claims 5 to 8, wherein the evaporation cell comprises a molecular beam epitaxy, MBE, source.

10. A method of in-situ characterization of functional devices comprising the steps of:

providing a vacuum chamber;

evacuating the vacuum chamber to near ultra high vacuum pressures of about 10^{-8} mbar or lower;

providing, inside the vacuum chamber, electrical connection to the functional device for measuring electrical properties of the functional device;

exposing a surface/interface of the functional device to a modification species;

measuring the electrical properties of the functional device in-situ upon the exposure to the modification species; and

providing an optical microscope system external to the vacuum chamber and illuminate the surface/interface of the functional device when disposed inside the vacuum chamber, and measuring optoelectrical properties of the functional device in-situ upon the illumination.

11. The method of claim 10, comprising illuminating the surface/interface of the functional device when disposed in the vacuum chamber through a view port.

12. The method of claims 10 or 11, comprising moving the functional device in the vacuum chamber to position the functional device in a fine focus position for the illumination of the surface/interface of the functional device.

13. The method of any one of claims 10 to 12, comprising coupling a vibration reduction or elimination mechanism to the vacuum chamber, the optical microscope system and the functional device.

14. The method of any one of claims 10 to 13, comprising using one or more of an evaporation cell for evaporating various materials inside the vacuum chamber and a gas-inlet for introducing various gases into the vacuum chamber.

15. The method of claim 14, comprising configuring the evaporation cell to direct the evaporated material towards the surface/interface of the functional device when the functional device is in a deposition position.

16. The method of claim 15, comprising configuring the evaporation cell to direct the evaporated material towards the surface/interface of the functional device when the

functional device is in a deposition position at a non-zero angle relative to an optical axis of the microscope system.

17. The method of any one of claims 14 to 16, comprising monitoring the evaporation rate of the evaporation cell.

18. The method of any one of claims 14 to 17, wherein the evaporation cell comprises a molecular beam epitaxy, MBE, source.