re-engineering the architecture of capacitors. The new capacitor device is a layered structure that incorporates thin electron and hole blocking layers deposited between the conducting electrodes and the dielectric material.

The quality of electrodes plays an extremely important role in all listed electronic devices. An important characteristic of electrodes is an ability to prevent considerable leakage currents. In particular, this property (quality) of electrodes is important for energy storage devices. In the electric-power industry super-capacitors are often used as energy storage devices. An increase in voltage on the electrodes of a capacitor (e.g., a super-capacitor) leads to increasing of the storage energy. The maximum value of working voltage is limited to a breakdown voltage of the capacitor. In turn, the breakdown voltage is affected by the quality of dielectric and, in particular, the degree to which the electrodes do not inject electrons or holes from electrodes and consequently do not provoke a breakdown of the dielectric of the capacitor.

SUMMARY

Embodiments of the present invention seek to overcome the drawbacks of the prior art super-capacitor electrodes by reducing the tendency of the electrodes to inject electrons in a dielectric layer of the capacitor (and to thereby decrease leakage currents).

An aspect of the present invention provides a multilayered electrode comprising an electro-conductive layer and at least one protective layer located on one side of the electro-conductive layer. The at least one protective layer may include a field-planarization layer, a tunneling injection blocking layer or a coulomb blocking layer or some combination of two or more of these. A field-planarization layer minimizes electric field enhancement due to geometric curvature on the surface of the electro-conductive layer. A tunneling injection blocking layer comprises a wide-band gap organic insulating material. A coulomb blocking layer comprises electron traps.

Another aspect of the present invention provides a multilayered structure for an energy storage device comprising a dielectric layer, and the multilayered electrode disclosed above and located on at least one surface of the dielectric layer.

A still another aspect of the present invention provides a film energy storage device comprising two multilayered structures disclosed above and laminated with each other. The laminated structure may be characterized by the following sequence of layers: multilayered electrode - dielectric layer - multilayered electrode - dielectric layer.