either the anode layer or the cathode layer is in electrical contact with the first conductive layer, and the electrolyte layer in contact with and completely separating the anode layer and the cathode layer, mounting an antenna to the support structure, mounting an electronic communications circuit to the support structure, and electrically coupling the electronic communications circuit to the battery and the antenna to transceive radio communications.

[0009] Yet another aspect of the present invention provides a combined battery and wireless-recharging apparatus including a support structure, a first conductive layer deposited on a first surface area of the support structure, a thin-film battery including a cathode layer, a solid-state electrolyte layer, and an anode layer deposited such that either the anode layer or the cathode layer is in electrical contact with the first conductive layer, and the electrolyte layer in contact with and completely separating the anode layer and the cathode layer, an energy-receiving device mounted to the support structure, and an electronic communications circuit mounted to the support structure and including a recharging circuit, the recharging circuit electrically coupled to the battery and the energy-receiving device to recharge the battery using energy received by the energy-receiving device.

[0010] In some embodiments, the anode or the cathode or both include an intercalation material or a metal or both, and wherein the electrolyte layer includes LiPON. In some embodiments, the cathode layer includes lithium cobalt oxide deposited on the first conductive layer, and the electrolyte layer includes LiPON.

[0011] In some embodiments of this apparatus, the energy-receiving device includes a photovoltaic cell. In some embodiments of this apparatus, the energy-receiving device includes an antenna. In some embodiments of this apparatus, the energy-receiving device includes an electromechanical electric generator. In some embodiments of this apparatus, the energy-receiving device includes an acoustic transducer.

[0012] Some embodiments of this apparatus further include a magnetic transducer. Some embodiments of this apparatus further include an acoustic transducer. In some embodiments, the apparatus operates as a hearing aid. In some embodiments, the apparatus operates as an implantable medical device. In some embodiments, the apparatus operates as a timepiece, for example as a watch.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] **FIG. 1A** is a cross-sectional view of a conventional lithium-ion battery.

[0014] **FIG. 1B** is a cross-sectional view of an energy-storage device according to the present invention.

[0015] **FIG. 1C** is a cross-sectional view of an energy-storage device according to the present invention.

[0016] **FIG. 1D** is a cross-sectional view of an energy-storage device and a supercapacitor according to the present invention.

[0017] **FIG. 2A** is a flowchart of a conventional method for manufacturing the lithium-ion battery of FIG **1A**.

[0018] **FIG. 2B** is a flowchart of one embodiment of a fabrication process according to the teachings of the present invention.

[0019] **FIG. 2C** is a flowchart of one embodiment of a fabrication process according to the teachings of the present invention.

[0020] **FIG. 2D** is a flowchart of one embodiment of a fabrication process according to the teachings of the present invention.

[0021] **FIG. 3A** is a diagram of a device for fabricating a thin-film battery according to the teachings of the present invention.

[0022] **FIG. 3B** is a diagram of a device for fabricating a thin-film battery according to the teachings of the present invention.

[0023] **FIG. 4** is a diagram of another embodiment of a device for fabricating a thin-film battery according to the teachings of the present invention.

[0024] **FIG. 5A** is a diagram of another embodiment of a device for fabricating a thin-film battery according to the teachings of the present invention.

[0025] **FIG. 5B** is a diagram of another embodiment of a device for fabricating a thin-film battery according to the teachings of the present invention.

[0026] **FIG. 6** is a diagram of another embodiment of a device for fabricating a thin-film battery according to the teachings of the present invention.

[0027] **FIG. 7** is a diagram of another embodiment of a device for fabricating a thin-film battery according to the teachings of the present invention.

[0028] **FIG. 8** is a cross-sectional view of a photovoltaic cell according to the teachings of the present invention.

[0029] **FIG. 9A** is a perspective view of a thin-film energy-storage device according to the teachings of the present invention.

[0030] **FIG. 9B** is a view of another embodiment of a thin-film energy-storage device according to the teachings of the present invention.

[0031] **FIG. 9C** is a view of another embodiment of a thin-film energy-storage device according to the teachings of the present invention

[0032] **FIG. 10** shows X-ray diffraction spectra of cathode films for thin-film batteries.

[0033] **FIG. 11** shows X-ray diffraction spectra of both a conventional cathode layer and a cathode film according to the teachings of the present invention.

[0034] **FIG. 12A** shows X-ray diffraction spectra for a conventional magnetron sputtered cathode layer.

[0035] **FIG. 12B** shows X-ray diffraction spectra for a thin film for an energy-storage device according to the present disclosure.

[0036] **FIG. 13** is an exploded perspective view of an electronic device with a separate printed circuit board and battery.

[0037] **FIG. 14A** is an exploded perspective view of a portion of an enclosure for an electronic device according to one embodiment of this invention.