Institut "Jožef Stefan" Ljubljana, Slovenija

TECHNOLOGY OFFER

INNOVATIVE BINDER-FREE ELECTRODES FOR SUPERCAPACITORS AND LITHIUM-ION BATTERIES

Fields of use

Surface treatment (painting, galvano, polishing, CVD, ...), Carbon nanotubes, Conductive materials, Nanomaterials, Micro- and Nanotechnology related to energy, Batteries, Power Supplies, Speciality/performance materials: producers and fabricators, Speciality/performance chemicals

Current state of technology

Under development/lab tested

Type of cooperation

Technical cooperation and license agreement to scale up and apply the technology

Intellectual property

Patent(s) applied for but not yet granted

Developed by

Jožef Stefan Institute

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Summary

A Slovenian research institute has developed novel electrodes for supercapacitors and lithium-ion batteries. The electrodes provide excellent high-frequency filtering properties, high reversible capacity and long-term stability. The institute is looking for producers of supercapacitors and lithium-ion batteries for technical cooperation agreements and license agreement to scale up and apply the technology in their production.

Description of the invention

A lithium-ion battery is one important type of a rechargeable battery for electric/hybrid vehicles. However, the use of these batteries is limited, if the device requires a rapid power supply. In such cases a supercapacitor can be used for the rapid delivery of the required energy.

Most of the currently available energy storage devices use carbon-based electrodes for the charge storage mechanism. Commercially available carbon-based electrodes do not meet the requirements for high-energy density applications due to their low theoretical capacity. Also, several alternative electrodes have been found unsuitable due to capacity fading after initial charge-discharge cycles and due to large volume expansions.

To address the above-mentioned issues of electrodes for supercapacitors and lithium-ion batteries, a Slovenian research institute has developed two novel types of electrodes prepared by low pressure plasma. The electrodes are made of nickel substrate, carbon nanotubes, each nanotube containing a single-crystal nickel nanoparticle with a trinickel disulphide layer and/or a nickel nitride layer. Both electrodes are binder free and show excellent properties.

The technology has been developed at a leading Slovenian research institute which is active on a broad spectrum of basic and applied research. The research group has a lot of experience in plasma systems, surface engineering and development of novel nanomaterials.

The research institute is looking for industrial partners for technical cooperation agreement and license agreement. Industrial partners should be companies that produce supercapacitors and lithium-ion batteries. Within the technical cooperation agreement, the partner sought shall, jointly with the Slovenian institute, scale up the method and employ the method in their production process. If the partner successfully implements the method in his production process, he will be invited to sign a license agreement.

KONZORCIJ ZA PRENOS TEHNOLOGIJ IZ JRO V GOSPODARSTVO

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

REPUBLIC OF SLOVENIA
MINISTRY OF EDUCATION, SCIENCE AND SPORT

The investment is co-financed by the Republic of Slovenia and the European Union under the European Regional Development Fund.

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Main Advantages

As a negative electrode for lithium-ion battery:
▪ the electrode has high reversible capacity (above 1000 mA·h/g after 100 cycles at a current density of 100 mA/g).
▪ the electrode has long-term stability (by maintaining a reversible capacity above 750 mA·h/g after 500 cycles at a current density of 200 mA/g).

As an electrode for a supercapacitor in high-frequency filtering:
▪ the electrode provides excellent filtering properties; electrode exhibited a phase angle above -75° and a capacitance above 400 µF at high-frequencies (above 100 Hz) with a cut-off frequency above 6000 Hz.

As an electrode for a supercapacitor for energy storage:
▪ electrode delivered a specific capacity of above 800 C/g during the chargedischarge cycling at a current density above 2 A/g, and the specific capacity retained above 80 % of the initial specific capacity (more than 600 C/g) at higher current densities (more than 10 A/g).

The electrode fabrication is done by a fast (less than 6 hours) two- or three-step procedure.

The process is performed without adding binders or other additive agents.

Partner Sought

Type: Companies that produce supercapacitors and lithium-ion batteries. Role: The role of partner sought is to jointly scale up the production of electrodes and employ the method in their production process within a technical cooperation agreement. If the partner is able to implement the method successfully, they will be invited to sign a license agreement.

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