●Development Stage

(Fiscal Year 2006-2008)

Fukui Central Area

Secure and Safe Energy Device Created with Nanoplating

Fukui Industrial Support Center
61-10 Kawaiwashizukacho, Fukui City, Fukui 910-0102 JAPAN
TEL: +81-776-55-1555

Life Sciences
IT
Environment
Nanotech Materials
Others

Framework for Project Promotion

Project Director……Tamotsu Tanaka (President, Tanaka Chemical Corporation)
Chief Scientist……Masayuki Takashima (Director, Headquarters for innovative society - academia corporation, University of Fukui)
Science and Technology Coordinator…Osamu Uesaka, Osamu Daido

Major Participating Research Organizations

Industry…KIYOKAWA Plating Industry Co., Ltd., Kuramo Electric Co., LTD., SAKAI OVEX CO., LTD., Sanei Electric Co., Ltd., SEIREN Co., Ltd., Tanaka Chemical Corporation, NICCA CHEMICAL CO., LTD., FUKUSHIN KOGYO Co., Ltd.
Academia…University of Fukui
Government…Industrial Technology Center of Fukui Prefecture, Wakasawan Energy Research Center, Japan Atomic Energy Agency

Core Research Organizations

University of Fukui, Industrial Technology Center of Fukui Prefecture

Aims of Project

Nanoplating technology, which is a basic technology in Fukui Prefecture, is applied to the construction of a sustainable society. To develop secondary batteries having a large capacity and high reliability, solar cells with high efficiency, and new far-IR gyrotrons equipped with a low loss waveguide line, fine materials with unique hybrid surfaces are produced using nanoplating technology. New hybrid materials for carbon-fiber-reinforced light metal alloy and high-tension wires are also developed. The commercialization of these new materials is promoted under the concept of “secure, safe and reliable.”

Contents of Project

1. Development of materials for lithium ion batteries of large capacity and high reliability
   A new cathode material for highly safe large lithium ion batteries, with the capacity of 180 $mAhg^{-1}$, for electric vehicles is being developed.

2. Nanoplated carbon-fiber-reinforced aluminum alloy that can be press-formed
   A new nanoplated carbon-fiber-reinforced Al alloy material having malleability and ductility is designed and prepared. This malleable and ductile carbon-fiber-reinforced Al alloy is applied as the covering material of the large lithium ion battery assembly for electric vehicles.

3. Portable power source equipped with high-efficiency tandem solar cell
   A high-efficiency tandem solar cell is developed as a light-energy conversion device. Using this tandem solar cell, new portable power sources for laptop computers and devices used during disasters, such as flashlights, radios and transceivers, is developed.

4. Lightweight high-tension cable fabricated with copper-plated aromatic polyamide fiber
   Supercritical CO_2 is applied to the preparation of a copper-plated aromatic polyamide (aramid) fiber having high tension and high electrical conductivity. The electric cable fabricated with the copper-plated aramid fiber is utilized in robot arms.

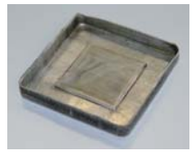
5. Development of terahertz devices and their application in the preparation of new materials for nuclear power systems
   A new heating system for preparing B4C for the control rods in nuclear reactors is established; it employs electromagnetic waves emitted from a 300 GHz gyrotron. The preparation technique of a waveguide tube with fine corrugations for the 300 GHz band is applied in the development of terahertz-band devices. The ultralow-loss waveguide for terahertz electromagnetic waves is prepared and applied to the horn-type high-sensitivity antenna in the terahertz region.

Main Results

1. A lithium-containing ternary transition metal composite oxide that exhibits advanced thermal stability has been developed as an active material of safe lithium ion batteries without sacrificing the large discharge capacity. The laminate type and the practical cells with the discharge capacities of 70 mAh and 30 Ah, respectively, have been fabricated and evaluated.


“The practical cell of 30 Ah”

2. A nanoplated carbon-fiber-reinforced aluminum alloy (CF/AL composite) has been developed. It is twice as strong as the one without CF. The reinforced CF/AL composite plate prepared in this project can be molded by warm pressing and can be bent with a 90°-angle corner.

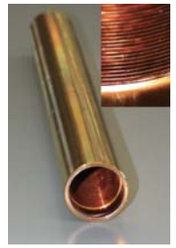

The molded plate of Cu-Ni double-layer plated CF composite Al alloy

3. For the development of a portable power supply equipped with high-efficiency tandem solar cells, we have established the following technologies: (1) fabrication processes of the solar cells, including the optimization of the design and structure of the electrode; (2) design and fabrication processes for a concentrator module integrated with lenses and solar cells.

4. We have prepared a 25 m copper-plated aramid fiber cable with electrical resistivity less than 0.61 Ω/m and resistivity regulation of less than 50%. When we compared the resistance to fatigue due to flexing of the conductive plating fiber (CPF) with that of the multiconductor cable, CPF was found to exhibit 50 times higher resistance than the conventional multiconductor cable.


Conductive plating fiber prepared with copper-plated aramid fiber

5. For the development of terahertz devices and their application in high-reliability nuclear energy systems, a method of fabricating a corrugated waveguide (32 mm(ID) x 300 mm(L)) with a micrometer-order corrugated structure was established.


A corrugated waveguide

Fukui Central Area (Development Stage) Grand Design

Secure and Safe Energy Device Created with Nanoplating

Knowledge Cluster of Ministry of Education, Culture, Sports, Science and Technology

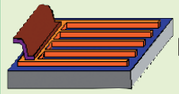
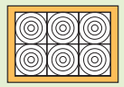
City Area Program (Basic Stage) → City Area Program (Development Stage)

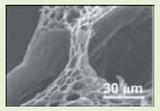

Development of materials for lithium ion batteries of large capacity and high reliability

Development of highly reliable secondary battery of large capacity using nanoplating technology


Nanoplated carbon-fiber-reinforced aluminum alloy that can be press-formed

Development of hot press technique for carbon-fiber-reinforced light metal alloy


Development of portable power source equipped with high-efficiency tandem solar cell

Development of emergency portable power source with technological seeds of high-resolution plating



Development of lightweight high-tension cable using copper-plated aramid fiber as an electric conductor

Development of high-tension composite cables with copper-plated aramid fiber as the electrically conductive wire prepared using supercritical CO_2


Application of new heating system with 300 GHz gyrotron to the sintering of B4C control rods of the nuclear reactor

Development of high-performance antenna for the terahertz band using technological seeds developed for the preparation of a low loss waveguide for the gigahertz band

Fields of application of products


Secondary battery for electric vehicle

Lightweight case of secondary battery for electric vehicle


Cable for robot arms

Portable power source

Instrumentation system for terahertz electromagnetic waves