●Basic Stage

(Fiscal Year 2007–2009)

Central Area of Osaka

Research and Development of Nanomaterials for Use in Next-Generation Sheet Devices

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Life Sciences
IT
Environment
Nanotech Materials
Others

Framework for Project Promotion

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Core Research Organizations

Osaka Municipal Technical Research Institute, Osaka University, Osaka Prefecture University, Osaka City University

Major Participating Research Organizations

Industry···Daiken Chemical Co., Ltd., Tomoe Works Co., Ltd., Okuno Chemical Industries Co., Ltd., Shimizu Co., Ltd., Kizai Corporation, Techno Agents Co., Ltd., Mitsubishi Paper Mills Limited, Nitto Kasei Co., Ltd., NEC Corporation, Mesh Corporation
Academia···Osaka University, Osaka Prefecture University, Osaka City University
Government···Osaka Municipal Technical Research Institute

Aims of Project

Central Osaka is home to a cluster of manufacturing companies from various industrial sectors, universities, and research institutes. This project intends to take advantage of these resources with the goal of developing next-generation sheet devices. This goal will be achieved by promoting research and development activities to create and provide functions for novel nanomaterials and to make thin films based on the nanomaterials. In the process of attaining this goal, we hope to establish fundamental technologies, enhance the competitiveness of local manufacturing companies, and revitalize the local economy.

As a joint research project involving industry, academia, and local government, private companies (mainly small- and medium-sized companies), universities, and research institutes located in Central Osaka will work together in a bid to establish the constituent technologies vital for the creation of flexible, next-generation sheet devices that incorporate electronic components, power supply, and a display. Moreover, part of the project will involve matching the developers/manufacturers of nanomaterials and parts with the manufacturers of home appliances, as well as establishing exchange programs. This will (i) ensure that the research results will lead to commercially viable projects, and (ii) enhance the application of the research results to a wide range of fields, including next-generation sheet devices.

Contents of Project

1. Creation of nanomaterials for use in the formation of fine wiring

The project first aims to develop the following low-cost, environmentally benign, and energy-efficient processes for the mass production of precisely controlled metal nanoparticles:
(1) controlled thermolysis and amine reduction methods using a metal complex as a precursor,
(2) a wet process using a supercritical fluid as a reaction field, and
(3) a wet process using a metal ion in an aqueous solution as a reducing reagent.
The project then aims to develop nanomaterials for fine wiring on a flexible polymer substrate using a screen printing method, and to design the microstructure and functions of the nanoparticles based on an understanding of their physical properties. At the same time, the project aims to improve the physical and electronic properties of the screen-printed fine wirings using an advanced nano-plating technique.

2. Development of nanomaterials for use in conductive adhesion, and establishment of low-temperature joining technologies

In order to mount electronic components on a flexible polymer substrate at low temperatures, this project plans to develop novel nonmaterials for use in conductive adhesion. These nanomaterials will be hybrid materials composed of metal nanoparticles with low-temperature sinterability and organic protective materials with a flux function. By applying novel nanomaterials to metal nanoparticle pastes and conductive adhesives as a replacement for solder, we intend to establish a highly reliable, advanced low-temperature joining technology that will be essential for making interconnections and mounting components for next-generation sheet devices.

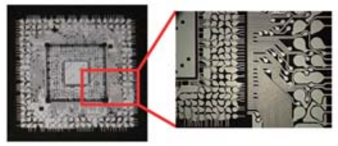
3. Development of all-inorganic, all-solid-state, thin-film energy-conversion devices

A thin-film lithium secondary battery is a safe and reliable energy-conversion device that is long-lasting and with a large capacity, while avoiding the problem of leaking electrolyte. Such a battery, mounted on a flexible polymer substrate, is needed to power next-generation sheet devices. To create such a battery, this project aims to develop the following constituent technologies:
(1) all-inorganic, all-solid-state battery materials to provide greater safety and higher reliability,
(2) thin-film batteries with a longer service life and greater durability, and
(3) search for and optimize techniques for constructing the interface between the electrode collector, the electrode active material, and the electrolyte, to achieve the desired high capacity.

Main Results

- Established a novel method of synthesizing nanoparticles for mass production using controlled thermolysis of metal complexes (Osaka Municipal Technical Research Institute).
- Prepared colloidal solutions of silver nanoparticles, achieved their high-density adsorption onto polymer substrates, and applied them to catalysts for electroless copper plating for PWB manufacture (Osaka Municipal Technical Research Institute).
- Established a new conductive adhesive with good long-term reliability (Osaka City University).
- Established the potential for preparing a conductive adhesive with great durability (Osaka University).
- Achieved low-temperature bonding at 300–350°C using metal nanoparticle pastes (Osaka Municipal Technical Research Institute).
- Synthesized $LiCoPO_4$ (a 5V class cathode material) as particles with a primary diameter of about 1 μm (Osaka Prefecture University).
- Achieved composition control of crystalline thin films that provide a good balance between electronic and ionic conductivity (Osaka Municipal Technical Research Institute).
- Made a trial preparation of a transparent conductive electrode with a specific resistance of 10^{-3} Ωcm, using ITO nanoparticle pastes (Osaka Municipal Technical Research Institute).
- Shipped samples of metal nanoparticle pastes (Daiken Chemical Co., Ltd.).
- Made a trial preparation of ITO nanoparticles and Ag nanoparticles for thin films (Tomoe Works Co., Ltd.).
- Created a transparent, conductive thin film using screen printing methods (Okuno Chemical Industries Co., Ltd.).

ITO nanoparticle paste for use in screen printing



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