

# TOSHIBA REVIEW

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## Special Reports

### Environmental Technologies for Harmony of Humans and the Earth

Special Reports Environmental Technologies for Harmony of Humans and the Earth	Feature Articles	Techno Notes	Toshiba Technologies for the New Century
*Environmental Corporate Management Leading to a Sustainable Society *Trends in Environmental Technologies for a Sustainable Society *Dye-Sensitized Solar Cells Using Solid Electrolytes *Novel CO <sub>2</sub> Absorbents Using Lithium-Containing Oxides *Hydro-eKIDS™ Compact, Low-Head Hydroelectric Power Generating Equipment Contributing to Solution of Global Warming Problem *1 kW Fuel Cell System for Residential Use *Lead-Free Solder Technologies for Electronic and Electric Apparatus *Decolorable Ink to Promote Paper Recycling *Environment-Friendly Multilayer Printed Wiring Board Materials *Environmental Information System for Developing Environmentally Conscious Products *Waste Home Appliance Treatment Process for Resource Recycling *Recycling Process for Polyurethane Resin *HM-1 PCB Detoxification Facility *Bioreactor Systems to Produce Valuable Resources from Organic Waste and Detoxify Organic Hazardous Materials	*Image Recognition LSI for Smart Cars Implemented Using Configurable Media-Processor *Power Transmission and Distribution Systems under Deregulation Schemes	*Meeting the Challenge of Medical Solutions	*5.Natural Language Processing

## Special Reports

### Environmental Technologies for Harmony of Humans and the Earth

**\*Environmental Corporate Management Leading to a Sustainable Society**  
MATSUMOTO Tadashi

**\*Trends in Environmental Technologies for a Sustainable Society**

FURUYA Tomiaki HARUKI Kazuhito  
The 21st century is referred to as the "century of the environment." Environmental issues have become related to all economic activities with many stakeholders involved, so that environmental legislation, environmental technologies, new environmental businesses, and so on are being developed at an unprecedented pace.

In this paper, environmental technologies are classified into four areas—"sustainable," "factor," "green," and "clean-up"—and the necessity of technology development in each of these areas is clarified. The importance of sharing environmental information through the product life cycle by the various divisions of an enterprise is also discussed.

**\*Dye-Sensitized Solar Cells Using Solid Electrolytes**

SUMINO Hiroyasu MURAI Shinji MIKOSHIBA Satoshi  
Dye-sensitized solar cells are a promising technology for realizing solar cells with high conversion efficiency and low cost compared to silicon-based solar cells. Unlike silicon-based solar cells, however, dye-sensitized solar cells contain liquid electrolyte. It has generally been difficult to achieve practical use of these cells due to leakage and vaporization of the liquid electrolyte.

Toshiba has succeeded in the application of molten salts as the electrolyte of dye-sensitized solar cells, and in the gelation of the electrolyte. A dye-sensitized solar cell using the solid electrolyte was shown to have a solar energy conversion efficiency of 7.3%. Toshiba's new technology makes it possible to supply reliable and low-cost solar cells with high solar energy conversion efficiency.

**\*Novel CO<sub>2</sub> Absorbents Using Lithium-Containing Oxides**

NAKAGAWA Kazuaki KATO Masahiro  
Toshiba has discovered a series of lithium-containing oxides that immediately react with ambient CO<sub>2</sub> up to 700 °C. The products react and return reversibly to the oxides at temperatures above ca.700 °C. The absorption capacity surpasses that of other CO<sub>2</sub> absorbents by a factor of 10.

Utilizing these absorbents, the possibility of a CO<sub>2</sub> separation system that operates at around 500 °C is proposed. It is generally believed that a CO<sub>2</sub> separation process operable at temperatures beyond 500 °C has the special benefit of a small energy penalty. Moreover, the absorption also proceeds at ambient temperature in the atmospheric environment. This property offers the possibility of many other applications, such as air cleaners or cartridges. We therefore believe that these are promising materials to contribute to the realization of CO<sub>2</sub> emission control.

**\*Hydro-eKIDS™ Hydro-eKIDS™ Compact, Low-Head Hydroelectric Power**

KOMAI Tsuneo SASANAMI Takeshi ODAGIRI Naruhito  
Nations throughout the world are making efforts to deal with the global warming problem, centering around carbon dioxide emissions. Among the measures available to reduce the greenhouse effect is the use of alternative renewable energy resources such as hydroelectric, solar, wind, and biomass power. In particular, hydroelectric power generation is superior to other energy resources from the standpoint of continuous, reliable power supply. However, the construction of large and medium-scale hydroelectric power stations is decreasing in order to minimize effects on the environment.

On the other hand, small-scale hydroelectric power equipment has potential in many areas such as municipal water, agricultural water, industrial water, and river water. Toshiba has developed the Hydro-eKIDS™ hydroelectric power generating system, which reduces construction costs for small-scale hydroelectric power generation.

**\*1 kW Fuel Cell System for Residential Use**

NAGATA Yuji ARAI Yasuhiro TANAKA Teruya  
In addition to its merits in terms of energy conversion and environmental protection, the proton exchange membrane fuel cell (PEMFC) can be operated with higher power density at low operating temperature. It can be applied to various fields including automobiles, stationary use, and mobile power sources. The fuel cell system for residential use, which supplies both electricity and hot water as a cogeneration system, is one of the optimal applications for PEMFCs, like automobiles.

We developed a 1 kW-class residential PEMFC system and verified its performance in FY2000. Based on this technology and the experience gained, commercial units will be realized within a few years by achieving further cost and size reductions.

**\*Lead-Free Solder Technologies for Electronic and Electric Apparatus**

MORI Ikuo TADAUCHI Masahiro MUKAI Minoru  
Toshiba began the application of lead-free solder to products from the year 2000 based on a lead reduction policy under the company's third voluntary plan. Three alloy systems (Sn-Ag, Sn-Zn, and Sn-Cu) are promising materials for lead-free solder. These solders are to be used according to the soldering process, manufacturing infrastructure, and guarantee level of product reliability.

As Sn-Ag solder provides excellent soldering, joint reliability, and handling in operation, it has already been applied to the mass-production of several household electric appliances. Sn-Zn solder has been applied to products with selected surface treatments of circuit boards and parts, and to reflow soldering with controlled temperature and humidity in printing.

**\*Decolorable Ink to Promote Paper Recycling**

SANO Kenji TAKAYAMA Satoshi MACHIDA Shigeru  
Paper, which accounts for about 40 % of the volume of trash, becomes trash because there is ink on the paper. If it were easy to erase the ink, sheets of paper would no longer be trash. This would also save energy and chemicals for the de-inking process, decrease carbon dioxide emissions, and preserve wood resources. Decolorable ink technology is applicable to toner for copiers and printers, ink for ballpoint pens, and common ink for printing.

Toshiba is developing the toner, and other companies are developing other items in cooperation with Toshiba. Six laws related to recycling were enacted in Japan in 2000, making it necessary for companies in Japan to give careful consideration to recycling. These laws have increased the need for decolorable ink for printers and stationery.

**\*Environment-Friendly Multilayer Printed Wiring Board Materials**

SUZUKI Tetsuaki IGARASHI Yutaka HAPPOYA Akihiko  
In current demand for printed wiring boards (PWBs), greatest attention is focused on two aspects: high-density packaging technology, accompanying the advancement of semiconductor packages; and environment-friendliness, with an emphasis on lead-free and halogen-free materials and the regulation of volatile organic compounds (VOCs). In the field of PWB materials, the shift to the use of various halogen-free materials is progressing at a rapid pace.

Toshiba has developed halogen-free FR-4 (TLC-555), whose usage started in the PC field; halogen-free resin-coated foil (RCF) (TLD-152), for use in laser via buildup and multilayer PWBs; and high glass transition temperature (Hi-Tg) halogen-free FR-4 (TLC-552Y), which is suitable for module and package substrates.

**\*Environmental Information System for Developing Environmentally Conscious Products**

KOBAYASHI Hideki HONGU Akinori SUZUKI Haruo  
The development of environmentally conscious products, which give customers satisfaction and provide environmental value, is one of the responsibilities of manufacturers.

Toshiba has developed technologies for an environmental information system that appropriately manages environmental data throughout the entire product life cycle and supports the development of environmentally conscious products (ECPs). It can also be incorporated itself into an existing product development process.

In this paper, we describe a supporting technology for the early phases of product development, a Web-based life cycle assessment (LCA) tool, and a technology for system integration. By applying these technologies, it becomes possible to explore the most effective environmental considerations while maintaining development efficiency.

**\*Waste Home Appliance Treatment Process for Resource Recycling**

KAWAMURA Yutaka AKIMOTO Hiroshi ICHIHASHI Toshio  
A new law on the treatment of waste home appliances came into effect in Japan on April 1, 2001, marking the commencement of full-fledged recycling of waste home appliances. The specified home appliance products that must be treated under the law are refrigerators, washing machines, air conditioners, and television sets. Among the constituent materials of these products are iron, copper, various plastics, glass, and printed circuit boards. Nishinohon Kaden Recycle Corporation (NKRC) was established for waste home appliance recycling in March 2000.

This paper presents an outline explanation of the recycling methods for waste home appliances used in NKRC and the recovery method for chlorofluorocarbons (CFCs). A performance evaluation of the plant was conducted, and it was confirmed that the plant conforms with the provisions of the recycling law.

**\*Recycling Process for Polyurethane Resin**

CAO MINH THAI SAYA Shioko  
Polyurethane used in refrigerators, automobile seats, and building materials can be decomposed chemically. However, the decomposition process is inefficient and has not been widely used up to the present time.

To increase the efficiency of the decomposition, Toshiba has developed a continuous decomposition process using an extruder. In this study, the properties of polyurethane and of epoxy resins reproduced from polyurethane decomposed by this continuous decomposition process were measured and compared with those of virgin resins.

**\*HM-1 PCB Detoxification Facility**

ADACHI Akira MURAMATSU Takehiko  
Since their development in 1881, polychlorinated biphenyls (PCBs) have been widely used in electrical equipment such as transformers and capacitors because of their good stability and electrical insulation characteristics. Toshiba has appropriately stored PCB-containing equipment used in each works, and the treatment of PCBs is a pressing need.

Last October, the Ministry of Health and Welfare approved the UV/catalyst decomposition process developed by Toshiba. At present, PCB detoxification facility named HM-1 is scheduled to be constructed in Kawasaki City with operation to begin within 2001.

**\*Bioreactor Systems to Produce Valuable Resources from Organic Waste and Detoxify Hazardous Materials**

IKEDA Michio MATSUSHIRO Takeshi ASHIKAGA Nobuyuki  
In the natural ecosystem, materials have been circulated without deficiency and the harmony of the environment has been maintained over a long period of time. Microorganisms have played an important role in this process. Recently, however, human activities have overloaded the natural ecosystem, far exceeding its processing capacity and giving rise to serious environmental problems.

Toshiba has been developing technologies to produce valuable resources from organic waste and detoxify organic hazardous materials by stimulating the natural capacities of microorganisms. Here, we present our biogas production system for kitchen waste and our bioreactor system for the decomposition of chlorinated organic compounds.

## Feature Articles

**\*Image Recognition LSI for Smart Cars Implemented Using Configurable Media-Processor**

KONDO Yoshihisa  
An image recognition LSI for smart cars has been implemented using a configurable media-processor. The configurable media-processor enables optimization for a specific application by means of design-time configuration. Therefore, the processor with the best cost-performance can be provided for most data-centric embedded system LSIs. Based on the configurable media-processor, a 4 GOPS (giga operations per second) 3-way VLW (very long instruction word) image recognition processor for an automobile system has been developed. Using a standard cell design method, the chip was implemented in a 0.25 μm CMOS process.

**\*Power Transmission and Distribution Systems under Deregulation Schemes**

TSUZUKI Tatsuo KUDO Yoshimasa KOBAYASHI Takenori  
Partial liberalization of power retailing was introduced in Japan on March 21, 2000 with retail wheeling schemes for eligible large-scale customers. In the near future, deregulation schemes will be expanded in the Japanese electricity supply industry and not only will new participants enter, but power utilities themselves will be promoting differentiation of services utilizing their individual strengths.

In response to these circumstances, Toshiba has developed products and a prototype to evaluate wheeling schemes which take power system security into consideration, fulfill the required responsibility between the power supplier and eligible customers, and provide advantageous services to distribution customers.

## Techno Notes

**\*Meeting the Challenge of Medical Solutions**

Toshiba Technologies for the New Century

\*5. Natural Language Processing