Innovating for Today and Tomorrow

We are accelerating innovation and differentiation as a management priority to quickly tackle dramatic changes in the global business environment climate. We are focusing on our six Next-Generation Growth Businesses and three of our Growth Businesses, whereby MCHC can create or strengthen its leading position in each of these promising areas.
**Lithium-ion Battery Materials**

The MCHC Group is the sole supplier of all four key materials in lithium-ion batteries (LiBs), namely electrolytes, anodes, cathodes and separators.

Separators can be manufactured using wet or dry processes. The dry process will likely be adopted widely to produce separators for electric vehicle batteries, as it is more cost-competitive and more suited to high power output.

In 2009, Mitsubishi Plastics started production of SEPALENT with annual capacity of 12 million m², a LiB separator that employs a proprietary dry process, combining low-temperature output and an outstanding life cycle. A new plant with 15 million m² per year is expected to launch its commercial production in 2013.

In 2011, Mitsubishi Plastics developed a highly cost-competitive heat-resistant separator for the LiBs market for electric vehicles. Using a coating with SEPALENT ensures heat-resistance of at least 200°C, helping to prevent batteries from short-circuiting. Furthermore, the company’s coating agent development capability and coating process technology accumulated over the years equip the new separator with superior cost competitiveness to other heat-resistant separators (made through a wet method) on the market. Following quality testing by manufacturers of LiBs, Mitsubishi Plastics plans to begin mass-producing these separators by 2013.

Other three key materials are produced by Mitsubishi Chemical. For electrolytes, in addition to other operation sites in Japan, the UK and the US, a new wholly-owned subsidiary in the PRC will have 10,000 metric tons of capacity per year by the end of 2012. Mitsubishi Chemical currently has a combined anode production capacity in Japan and the PRC of 11,000 metric tons and intends to raise Chinese capacity in the autumn of 2012 by 4,000 metric tons. Annual capacity of cathode is 2,200 metric tons.

The MCHC Group will continue to develop its LiB materials business by providing all four key materials. The Group will offer optimal material solutions to meet customer needs, provide the products with consistent quality, and establish a stable supply network.
White LED Lighting and Materials

A key feature of Mitsubishi Chemical’s white LED lighting and materials business is that it encompasses gallium nitride (GaN) substrate and phosphor technologies. The company’s substrate has a high-quality, single-crystal structure. It is made using HVPE, for hydride vapor phase epitaxy, a technique developed over many years that employs epitaxial technologies and compound semiconductor processing technologies. This has resulted in good uniformity, high crystallinity, and superior surface quality.

Mitsubishi Chemical has already established a mass-production technology for GaN substrates that employs the Super Critical Acidic Ammonia Technology method, which ensures higher quality, low dislocation density, and productivity. In April 2012, the company completed proving facilities at the Mizushima Plant and started making crystal samples. It looks to launch mass production in 2013.

Mitsubishi Chemical’s phosphor business is focusing on the lighting market. It aims to maintain and further raise its high market share in red phosphors while bolstering its lineup of the green and yellow versions. It also looks to begin accommodating remote phosphors, attaining a full phosphor lineup.

Mitsubishi Kagaku Media Co., Ltd., a subsidiary of Mitsubishi Chemical is also selling LED lighting products for consumer and business applications globally under the Verbatim brand. In line with augmenting our LED light bulb lineup, in July 2012, in Europe, we introduced a complete family of cost-effective retrofit LED lamps for households. The new lineup comprises 13 products including LED lamps to replace 25W to 60W Classic A bulbs and 15W to 25W Classic B candle lamps. Color temperatures range from 2,700K to 3,000K, and each model has a minimum color rendering index of 80.

Road map for gallium nitride substrates

2012 Inaugural year for lighting applications
Jan. Commercialize high-quality c-plane substrates
Oct. Commercialize high-quality two-inch m-plane substrates

2013 Fully enter the LED lighting market
Apr.-Oct. Start mass production furnace operations
Commercialize high-quality four-inch substrates and launch full-fledged production

2015 Planning to fully enter the electronic devices market
Oct. Commercialize high-quality six-inch substrates

Innovating for Today
Growth Businesses

![A Verbatim LED light bulb](image-url)
We are creating carbon fiber–reinforced plastics technologies for mass-produced vehicles. These technologies contribute greatly to lightness, lower CO2 emissions, enable more flexible vehicle designs, and help cut the numbers of parts and components. These materials should drive the popularity of electric and fuel cell vehicles.

For thermosetting, we are conducting development through our proprietary prepreg compression molding technique to shorten the molding cycle to less than three minutes. For thermoplastics, we are working on samples and development for complex shapes and large parts for stampable sheet and long-fiber-reinforced thermoplastic and direct long-fiber-reinforced thermoplastic techniques. We aim to complete these efforts by 2015, applying our techniques for the trunk lids and engine hoods of luxury cars. From 2015, we aim to have our carbon fiber–reinforced plastics technologies applied to mass production for the general vehicle market.

For wind-powered generation systems, we leverage our supply strengths in polyacrylic nitrile and pitch, providing these materials for large wind turbine blades. We are leveraging a business alliance with Cytec Industries Inc. of the United States to enter the aerospace field.
Organic Photovoltaic Modules and Materials

Organic photovoltaic modules (OPVs) are more flexible and lighter than conventional crystalline silicon-based counterparts. The key to practical usage is enhancing conversion efficiency. Having attained a world-leading conversion efficiency of 11%, Mitsubishi Chemical aims to raise this level to 15%, commercializing its OPVs by 2015. The company is also building pilot facilities to manufacture larger modules. OPVs are made using printing processes, making them suitable for mass-production applications that include buildings and car bodies. Mitsubishi Chemical is marketing its amorphous silicon photovoltaic modules, which are flexible and light like OPVs, to cultivate the OPV market.

Organic Photo Semiconductors

In June 2012, Mitsubishi Chemical and Pioneer Corporation developed organic light emitting diode (OLED) elements using a wet process for the light-emitting layers. OLED devices from this joint project resulted from combining innovative proprietary light-emitting materials with a Mitsubishi Chemical–developed wet process and jointly optimizing the device structure and wet process. The devices offer sufficiently long service lives and efficiency to make them commercially viable for lighting applications.

Assuming a 70% lifetime and a white luminance of 1,000 cd/m², the white elements provide a lifetime of 57,000 hours. The high-efficiency full-color version delivers an efficiency of 56 lumens per watt at 2,000 cd/m². Penta-Ocean Construction Co., Ltd., chose to install the VELVE-brand organic lighting panel at its headquarters building because of the panel’s outstanding thinness, light structure, soft lighting and dimming, and color matching functions.
**3 Advanced Performance Products**

Mitsubishi Plastics and Union Industry Co., Ltd., developed an easy-to-install compact adsorption chiller with an integrated cooling tower that delivers a cooling capacity of 10 kilowatts. The chiller uses the zeolitic water vapor adsorbent AQSOA and can be incorporated in a solar water heater, helping reduce electricity consumption by up to 20% when the chiller is combined with a cogeneration system.

Mitsubishi Plastics began manufacturing heat exchangers and other parts coated with AQSOA in 2008. That adsorbent can efficiently release water vapor even at relatively low temperatures. Because heat exchangers coated with AQSOA can reduce energy consumption, the parts are already being used in many adsorption chillers in Japan and Europe. Another advantage of AQSOA is that its superior durability lowers maintenance requirements, thus cutting running costs.

**4 Healthcare Solutions**

MCHC is orchestrating Group strengths in providing solutions to satisfy unmet medical needs. We have developed several healthcare solutions. One example is the carbon dioxide bath unit to create carbon dioxide rich water, for which the benefits include increased blood flow. The unit employs Mitsubishi Rayon’s hollow fiber membrane technique. Potential applications include rehabilitation, nursing care, health promotion, and beauty care. One of other achievements is the MIMAMORI-Gait system, which employs the proprietary analytical technologies accumulated at our chemical plants. We have released this product as a medical device. We have developed an enclosed plant factory system and will evaluate applications for this system in pharmaceutical manufacturing.

**5 Agribusiness Solutions**

In Japan, we became involved in a plant factory project of the Ministry of Agriculture, Forestry and Fisheries, and have started demonstration tests. We are growing seedlings under completely artificial light while using sunlight in greenhouses to grow tomatoes. We partnered with China Co-op (headquarters Nanjing, Jiangsu) to start plant factory experiments in Wuxi. We plan other tests in Nanjing, Beijing, and Jilin. We are looking to set up a company to manufacture and sell high-performance film for plant factories, expanding our plant factory business in the PRC.

**6 Sustainable Resources**

GS Pla from Mitsubishi Chemical is a polybutylene succinate-based resin that is biodegradable—it decomposes into water and CO₂ in the natural environment. These qualities have made GS Pla an ideal material for agricultural film and tableware, reducing energy consumption and the cost of waste disposal.

Another fruit of Mitsubishi Chemical’s sustainable resources endeavors is DURABIO, a transparent bio-based engineering plastic that is not only biomass-derived but also has higher optical properties than conventional transparent plastics. This product is durable against discoloration from light and resists heat and impact. Mitsubishi Chemical is drawing on these properties in applying the product in such diverse areas as advanced optical materials, automotive bodies and interiors, building materials, and as an alternative to advanced glass.