Building Value through Robust R&D Activities and Intellectual Property Initiatives

Our R&D activities draw on synthetic technologies that we have amassed since starting out in coal mining, and we continue to carry out a variety of R&D activities to date. We also undertake strategic intellectual property initiatives that are vital to corporate growth while endeavoring to avoid intellectual property infringements.

R&D

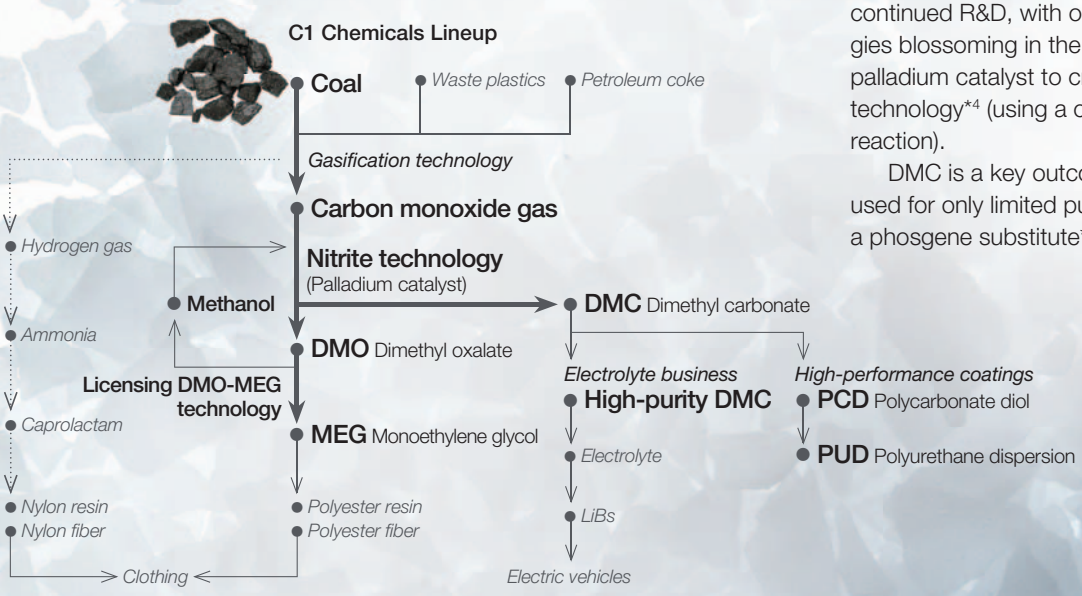
Harnessing Proprietary Synthetic Technologies to Develop Products and Pursue Licensing

C1 Chemistry*1 Technologies Centered on Dimethyl Carbonate

Over the years, we have synthesized chemicals based on raw materials sourced in-house to pursue higher added value. As a result, C1 chemistry has become a world-renowned technology, not only for the creation of dimethyl carbonate (DMC) and dimethyl oxalate (DMO) but also for the synthesis of derivatives such as polycarbonate diol (PCD)*2 and polyurethane dispersion (PUD)*3, and heterocyclic compounds that are part of drug substances. This continues to be a source of profit for the Group.

Our efforts to derive oxamides to be used as fertilizer by using a synthetic gas (a mixture of carbon monoxide and hydrogen) from coal helped us to pioneer our organic chemistry. We thereafter continued R&D, with our C1 chemistry technologies blossoming in the 1970s after we used a palladium catalyst to create a proprietary nitrite technology*4 (using a carbon monoxide coupling reaction).

DMC is a key outcome of our efforts. It was used for only limited purposes when marketed as a phosgene substitute*5 for carbonate synthesis



Masayoshi Oota
Senior Executive Officer, General Manager, Research & Development Div., with responsibility for Technology Development Dept. and development section, Chemicals Company

Glossary

*1 C1 chemistry: A technology that uses carbon monoxide and other one-carbon molecules to create other compounds incorporating carbon.
*2 Polycarbonate diol: Please see page 27 for details.
*3 Polyurethane dispersion: Please see page 27 for details.
*4 Nitrite technology: A clean synthesis technology that uses carbon monoxide and methanol as raw materials.
*5 Phosgene substitute: Phosgene is a raw material for PCD and polyurethane, but has been replaced by other chemicals in recent years owing to its high toxicity.

Microscope image of polyimide porous membranes

Key R&D Focuses That Could Enhance Our Competitiveness

Category	*Focus*	*Advantage*
Healthcare	Bioreactor systems	Building a cell culture system employing our proprietary polyimide porous membranes
Construction and infrastructure	Urethane-based prevention method for falling concrete pieces	Product development that brings together our construction materials channels and organic chemistry
Mobility	New battery material (lithium titanium oxide)	A robust battery materials channel
	Ceramic matrix composites for next-generation aircraft	Developing products harnessing our patented Tyranno Fiber®

because of a reputation for poor reactivity. We were about to stop production, however, we discovered that incorporating small amounts of an additive resulted in DMC becoming a much better electrolyte than existing counterparts in lithium-ion batteries (LiBs). Since then, this organic compound has been a core product for us, particularly as an electrolyte.

We have progressed steadily in developing derivatives, and have extended our PCD manufacturing network* to include sites in Thailand and Spain. We have also developed and commercialized such high-value-added offerings as PUD, which are derived from PCD.

In recent years, we have augmented the licensing business of our C1 chemistry technologies internationally. A good example is the technology for monoethylene glycol (MEG). This is made from DMO, which shares the same raw materials as those of DMC. We have licensed production of more than 12 million metric tons of DMO and more than 6 million metric tons of MEG.

MEG is a compound whose market is growing as a raw material for polyester fibers used in apparel and polyethylene terephthalate resins, commonly for plastic beverage bottles. While hydrogen is needed to make MEG from DMO, the synthetic gas that is a raw material of DMO already incorporates hydrogen. Our production process for MEG is thus highly regarded because it minimizes environmental impact. China's national policy of harnessing coal as a raw material for chemicals rather than as a fuel is contributing to a bright future for our technology.

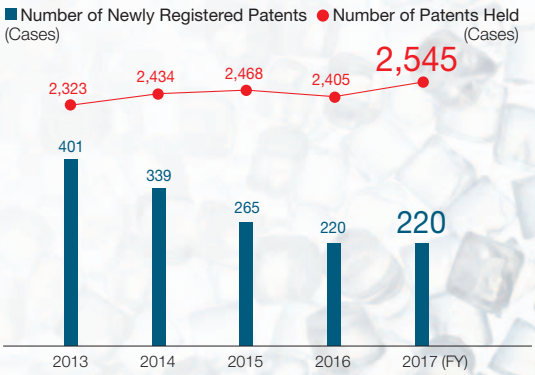
* *Please see pages 26–27.*

Intellectual Property (IP)

The UBE Group's initiatives to reinforce and optimally leverage IP aim to enable us to create new businesses and bolster competitiveness, thereby helping to build and expand enterprise value.

We seek to maximize our enterprise and IP value by formulating IP strategies according to our business strategies and by implementing the plan–do–check–act (PDCA) cycle of IP strategy activities. Furthermore, to strengthen IP research and analysis capabilities, we are working to improve operational efficiency, including in R&D departments, by utilizing tools with artificial intelligence (AI) functions and to utilize IP portfolios*1 and open/close strategies*2 while promoting IP activities that contribute to business revenue. At the same time, we are promoting global IP management as the UBE Group, and are advancing the sharing of activity policies and IP information with Group companies in Japan and overseas.

Number of Domestically Held and Newly Registered Patents



Glossary

*1 *IP portfolios: Patents, copyrights, know-how, and other intellectual property that corporations can use to formulate strategies and assess competitiveness*

*2 *Open/close strategies: Management strategies that give companies competitive edges by making intellectual property open or closed*