JACI NEWS LETTER
Japan Association for Chemical Innovation

No.53 2014.10

HEADLINE

GSC in a New Era
– toward GSC-7

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Makoto Misono

GSC-7 will be held in Tokyo in July. An international conference that originated in Japan will be held again in Tokyo, having journeyed across the world for 12 years.

When a call for green chemistry (GC) was made in the 1990s by countries abroad, Japan had already been an advanced country in environmentally harmonious chemical technology. In response to such an initiative, Japan decided to promote the activity by combining the efforts of people in industry, academia and government. The Japanese program, placing stress on "technology" aimed at the achievement of a sustainable society, was eventually named "GSC (green sustainable chemistry) ." Subsequently, both GC and GSC have made steady progress. In the meantime, circumstances have changed, and voices have been heard asking whether GC/GSC is sufficiently making its presence in chemical technology and the chemical industry, and whether it is working adequately fostering guiding principles. Furthermore, despite the implementation of a number of national projects, even now, people ask, "What does GSC boil down to in a few concrete terms?"

Consequently, I believe that now is the best chance to answer these questions, give renewed thoughts to creative chemical technology that is truly benign to the environment, build a concept of GSC well-attuned to a new era and help create awareness of it in the public outside the realm of chemistry.

Stated bluntly, the principal goal of GC and GSC has up until now been to reduce the waste products and harmful substances discharged by existing chemical processes and products, that is, striving to achieve that which is less negative. The definition of eco-efficiency = performance /environmental impact, indicates that not only reducing the environmental impact, which is the denominator, but also improving the performance of the numerator is equally effective. In other words, we may widen the scope of GC and GSC, by making a 180-degree turn on our approaches: from less negative, to more positive. Given this transformation, goods and services take the main stage, and the question becomes not only *How to make?* (manufacturing processes) but also *What to make?* and even *Why do we make them?* (goods and services) . *Why do we make them?* means that, by going back to the fundamental reasons why given goods and services are needed, we may devise completely different goods and services that fulfill a given set of needs. With these approaches, the range of application of GC and GSC will expand. In addition, more effective approaches would be discovered if one considers the whole (systems, wide areas and LCA) , beyond specific goods and services. By pursuing these thoughts, GSC may be able to transform itself into a creative (positive) GSC that ushers in new values and contributes to the execution of technological strategies for businesses.

Thirteenth GSC Award

Green Sustainable Cher

Thirteenth GSC Award and ENV Minister Award

Development and Practical Use of a New Paint which enable reduction of VOC and Ship Hull Friction

Chugoku Marine Paints, Ltd.; Hitachi Chemical Company., Ltd.; the National Maritime Research Institute; the Cooperative Association of Japan Shipbuilders; and the Yuge National College of Maritime Technology

The antifouling paint applied to the bottom of a ship for the purpose of preventing the attachment of marine organisms also functions to minimize an increase in the resistance of the ship hull due to the attachment of marine organisms. In this project, we developed an environmentally benign antifouling paint, "SEAFLO NEO," that substantially reduces the amount of volatile organic compounds (VOC) through the use of a newly designed hydrolysis resin (polymer), which is the main component of the paint. This work demonstrates that, in addition to the capability of the conventional antifouling paint, the formation of a smooth paint film that further minimizes the frictional resistance contributes to the reduction in navigation fuel costs and CO_2 emissions.

For Japanese industry, the transport of goods plays a critical role. In the case of imports into Japan, 99.7% of the cargo on a volume basis is transported on the waters. From a worldwide perspective, environmental regulations aimed at reducing carbon dioxide gas emissions from the ships have begun, as promulgated by the International Maritime Organization (IMO). Thus, the shipping industry is a focus of attention in both economic and environmental points of view.

The antifouling paint applied to the bottom of a ship performs the function of curbing an increase in the resistance of the ship hull due to the attachment of marine organisms. Antifouling paint containing Organotin compounds (tributyl tin and triphenyl tin) developed in the 1960s had provided excellent antifouling performance; however, ecological and environmental issues (endocrine disruption effects) associated with those compounds led to the ban of the manufacture and sales of those paints in Japan in 1997. The year 2008 saw a complete ban of those paints across the world, by a ruling adopted by the IMO. Subsequently, in place of the organotin compounds, silyl acrylate polymers and metal acrylate polymers have taken over. They provide decontamination mechanisms by which, when exposed to seawater, hydrolysis functional groups dissociate by ionization and serve to renew the surface of the painted surface.

The project team has successfully commercialized "SEAFLO NEO" by demonstrating reductions in volatile organic compounds (VOC) in a ship-bottom antifouling paint, through analyses of the drying process and paint surfaces after the paint was applied and proving that the product is capable of reducing the frictional resistance of the ship hull during navigation. Beyond reducing the environmental impact during the manufacturing process, the new product improves the work environment during the paint use process, reducing the volume of CO_2 emissions as a measure of reducing fuel cost during the navigation, reducing the amount of use of fossil fuel resources, and thus has contributed to global GSC.

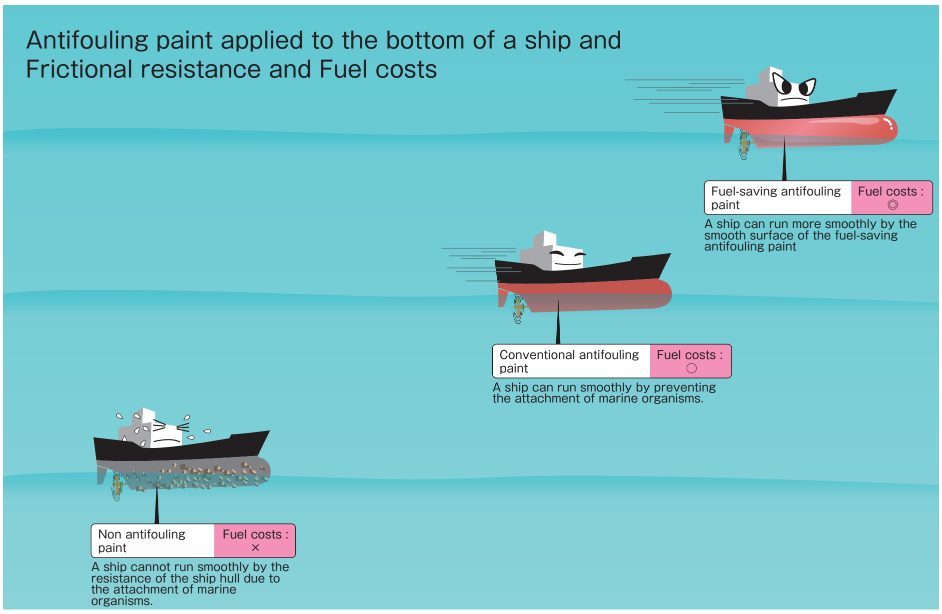
The key to the developmental effort lies in a paint design using a hydrolysis resin. "SEAFLO NEO" incorporates a new polymer different from conventional ingredients. We studied a paint film drying process that exhibits new rheology behavior by prescribing a paint that forms a metallic cross-linkage as a hydrolysis group. Techniques of increasing the particle density during mist formation by spray painting and improving the initial fluidity by delaying the initial curing process reduce the splashing of spray dust during the paint coat application process, when compared with the conventional antifouling paint, and significantly contribute to the formation of smooth paint film surfaces.

For the verification of the frictional resistance reduction effect, we conducted tests using a "Double Cylinder Friction Resistance Equipment"; the results indicate that, compared with conventional products, "SEAFLO NEO" delivers a 6 to 10% torque reduction (frictional resistance reduction effect).

On an actual ship, demonstration field tests conducted using the training ship "Yuge-Maru" confirmed a 1.8% horsepower reduction effect.

"SEAFLO NEO" already has a track record of having been adopted on over 150 vessels, and the numbers are increasing further. Calculations on the environmental benefit effects of "SEAFLO NEO" indicate that, when applied to a given structure, the new paint permits more than 40% reductions in the volume of VOC emissions when compared with conventional paint. The new paint's fuel cost reduction effects based on fuel cost analyses conducted on real ships have also been confirmed. Therefore, as an additional benefit, reductions in the volume of CO_2 emissions can also be produced.

"SEAFLO NEO" continues to evolve as a series of fuel-saving antifouling paint products; we have put in place an expanding list of products. It is hoped that the new paint will continue to provide benefits as it makes a positive impact on the industry.



mistry Award

Following a last issue, We are pleased to present the award-receiving research works of the 13th GSC Award and the Third GSC Incentive Prize.

Third GSC Incentive Prize

Development of a clean oxidation method of producing functional chemicals using hydrogen peroxide as an oxidizing reagent

Sumitomo Seika Chemicals Co., Ltd.: Shun Hashimoto, Yuji Kinpara, Nobutaka Fujimoto
National Institute of Advanced Industrial Science and Technology（AIST）: Yoshihiro Kon, Kazuhiko Sato

Compared with other oxidizing protocols, the use of hydrogen peroxide leads to clean oxidation methods, where the unique by-product is water. Hereby, a new oxidation process which involves hydrogen peroxide and PTMA*, a type of radical polymer, is described and its scale-up successfully achieved to pilot plant scale. Compared with conventional methods, the new process permits a halogen-free and safe production of PTMA. Additionally, high efficiency levels in the use of hydrogen peroxide were obtained. Moreover, the amide-based solvent, used in this process offers a high degree of affinity, suggesting the possibility to expand this technology to a wide number of substrates.

* poly（2, 2, 6, 6-tetramethylpiperidine-1-oxyl methacrylate）

Since the 70s, radical polymers that survive for a long period of time at room temperature and under an atmospheric pressure have been objects of a number of research results as oxidation-reduction capable resins. They represent functional chemicals offering properties springing from a propensity to *undergo oxidation-reduction reactions in a reversible manner*, acting as oxidation catalysts from alcohols to aldehydes and ketones, and recently, providing potential application to electronic devices.

Conventionally, the oxidizing agents used in oxidation reactions for the production of radical polymers were organic peroxides with a high explosion hazard, such as peracetic acid and *m*-chloroperoxybenzoic acid. In addition, the use of large quantities of organic solvents（halogen-based solvents）was required to dissolve the polymer, producing a significant adverse environmental impact. Due to these issues, such conventional oxidizing agents hindered efforts to synthesize radical polymers in mass production quantities.

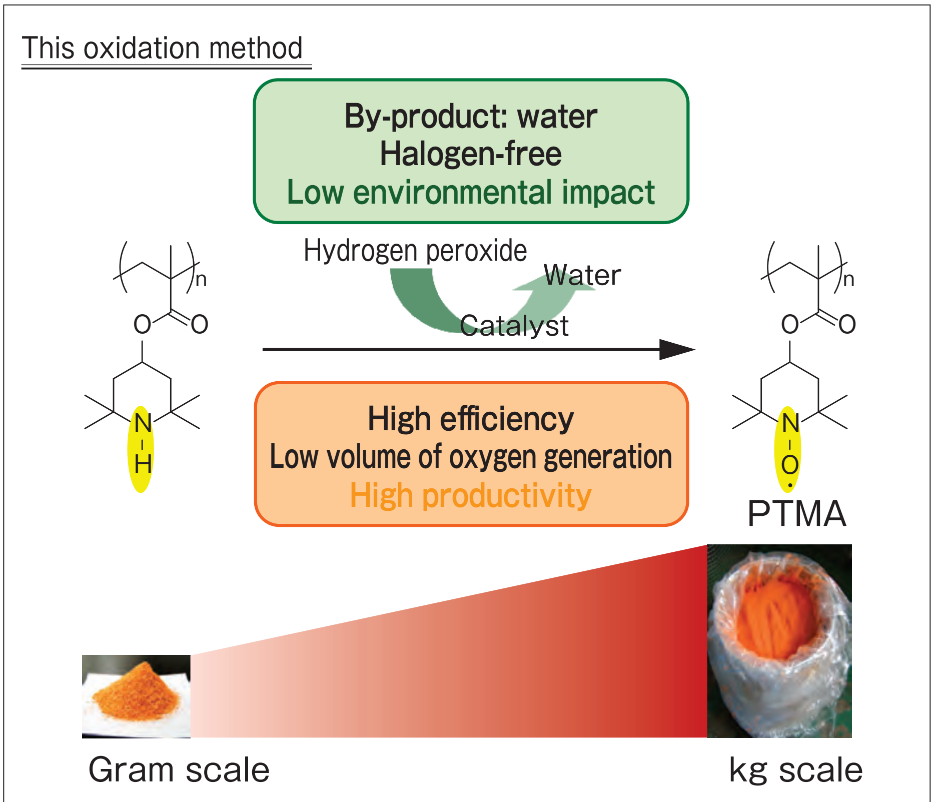
At Sumitomo Seika, the oxidation reaction for the production of radical polymers has been studied. Initially, conventional methods required the use of a large excess of hydrogen peroxide in order to get a high oxidation rate in the production of PTMA. Furthermore, the generation of large quantities of oxygen gas from the decomposition of the hydrogen peroxide during the reaction led to a limitation from the viewpoint of industrial production. Consequently, the reaction entailed an extremely high load during the manufacture. In order to achieve these issues, a joint research effort with AIST for the development of a process based on clean oxidation by hydrogen peroxide for the preparation of the radical polymer, PTMA was established.

The research involves the development of a catalyst to enhance reactivity. A solvent was found as well, an important key aspect of the process. By the fine-tuning of catalyst design and solvent choice, we were able to establish a protocol that maximizes the practical efficiency of hydrogen peroxide and produces radical polymers in the absence of halogen at high efficiencies.

The process has been proven to be "scalable" up to a 10-kg scale. Even at a large scale, the process achieved a higher degree of safety than that of a conventional process because it decreases the amounts of oxygen gas（or, O_2）production.

Morever, beyond the various radical polymers tested, the applicability of this new oxidation technique developed by this work can be extended to other functional chemicals. Particularly interesting substrates are those that require high purity and halogen-free processes.

The radical polymers produced following this process offer even the high degree of purity required in the manufacture of electronic devices. In addition, as the solvent used has a high degree of affinity, we believe this low-environmental impact, safe and highly efficient process can be applicable as well to other types of substrates, contributing to GSC.



Synthesis of PTMA using a new safe and clean method

JACI NEWS LETTER
Japan Association for Chemical Innovation

Strategy Committee

[Five-Year Chemical Technology Strategy]
Innovations in Automobile Materials from the Chemical Industry

In the last issue, JACI reported that the [Five-Year Chemical Technology Strategy as an Aim of the Chemical Industry] was proposed in three installments between 2012 and 2014. This issue presents a summary of the [Provision of goods and services (automobile materials) anticipating future lifestyles] that was published in June 2014.

Among the fields of goods and services that are projected to undergo significant changes in needs due to societal changes over the next 10 to 20 years includes an automobile. The automobile is deeply intertwined with the chemical industry, and it represents a field beset by a wide variety of technological issues that the entire chemical industry must address. Looking ahead to the year 2030, the JACI has sorted out issues surrounding the automobile and the societal changes that are likely to affect it, and from that perspective has conducted discussions on the technological issues and the solutions for which the chemical industry must contribute.

In terms of needs in automobiles, whereas the U.S. requires large vehicles & long distances, Europe and Japan are mainly interested in low fuel consumption, environmentally conscious cars, while developing countries have deep-rooted needs in low-priced cars. Thus, we are faced with a wide diversity of needs. These trends seem to continue until 2030. Amid the coexistence of a variety of powertrains (internal combustion engine, EV, HEV and FCV), we anticipate the need to respond to energy conservation, safety, greater comfort and environment. In fulfilling these needs, irrespective of the specific type of powertrain deployed, a critical requirement in achieving energy conservation (increased fuel economy) will be reducing the weight of the vehicle body. The achievement of a secure, safe and comfortable driving environment requires the installation of various sensors and control systems on the vehicle, and a technology that accurately controls these components.

Given the above background, for a future automobile within the realm of conception by the chemical industry, we have proposed an "all-plastic small EV mobility" car that achieves ultra-low fuel consumption, high efficiency and zero gas emissions, as well as a "flexible electronics implementation" for on-board information and control systems that deliver a lightweight, secure, safe, comfortable driving experience.

Table 1. Innovative technology for transformation to lightweight plastic raw materials

Component	Current material	Innovative technology to be implemented	
Floor pan	Steel	Thermoplastic CFRP batch molding	
Exterior Plate	Steel	Two-color injection Compression molding In-mold junction	Long-fiber reinforced thermoplastic resin
Window	Glass		Ultra-weather resistant hard coat polycarbonate
Seat	Steel Urethane Foam	FRP + fiber nets, etc.	
Wheel	Rubber Steel	Air-free filling type (non-blowout) tire wheel resin spoke-integrated structure	

The conversion of vehicle components from metal to plastic may achieve substantial weight reductions with a quantum jump in fuel economy. Furthermore, the streamlining of the production process, such as single-process molding that is not feasible with metals, reductions in the number of parts and a capability to accommodate small-lot production may become possible. Table 1 summarizes various topics that the chemical industry is expected to address, for transformation of heavy components made of steel, glass, and rubber, such as floor pans, exterior plates, windows, seats, and wheels, into lightweight plastic materials.

Table 2. Technological innovation for the protection of the electronic environment based on flexible electronics

Component	Current material	Innovative technology to be implemented
Wires	Copper wire	Polymer optical waveguide Multiplexed signal transmission
On-vehicle wireless communications	Electromagnetic waves	Two-dimensional flexible communication sheets for evanescent wave-based wireless communications
EMC		Flexible printed Faraday gauge
Dimming	Low-E glass	Dimming mirror sheet Electro-chromic dimming sheet
Air conditioning	Heat pump	Large-area flexible Peltier device

The operation of in-vehicle systems, including driving support and automated driving ensuring safety and comfort, requires the protection of the electronic environment, including the prevention of malfunctions. As listed in Table 2, flexible electronics technology fostered by the chemical industry, permitting the conversion of copper wires to polymer-based optical waveguides, and the introduction of dimming windows for visibility assurance and heat-blocking, is expected to provide innovative technology that leads to weight reductions and protects the electronic environment in the automobile.

In this proposal, in conjunction with the solution to non-technical problem, including the establishment of a battery recharging infrastructure, we conclude that the chemical industry must promote the development of new materials for the realization and implementation of innovative technologies and in a further move the chemical industry should take the lead in moving technological innovations forward by involving the automobile industry, the automotive parts industry and the electronics / communications industries.

For those of you who might be interested in reading the entire text of the proposal, we will be pleased to send you the booklet. For further details, please visit the following website of the JACI:
http://www.jaci.or.jp/public/page_03.html

Holding an International Interchange Forum with the People's Republic of China and Germany

The Frontier Coordination Committee, with the objective of addressing internationalization, beginning this year established the "International Interchange Forum" program, inviting representatives from international research organizations, and has already held two such conferences.

For the first meeting on April 15, the Committee invited the Industrial Technology Research Institute (ITRI) of the People's Republic of China (Taiwan) from the Asian region. With a workforce in excess of 5,800 persons, ITRI has an effective patent compilation of 20,000 titles; it is conducting applications research on a scale surpassing that of the National Institute of Advanced Industrial Science and Technology (AIST) in Japan. After presenting an overall introduction of the ITRI by video, the forum heard talks by Deputy General Director T. M. Lee of the Material and Chemical Research Laboratories, which is conducting a developmental program centered on chemical materials, and from five participants, including the Material and Chemical Research Laboratories group leaders, regarding developmental topics (two lithium secondary battery projects and one fire-retardant material project), as well as business implementation initiatives for those topics. In the area of lithium secondary batteries, the speakers described safety improvement techniques using nanotechnology. The meeting, attended by approximately 50 persons, revealed that the ITRI is conducting an all-out effort to strengthen ties with businesses in and out of Taiwan and has launched companies spawned from technology transfers. This piqued the interest of the audience and led to an intense question and answer session. Days later, there was a newspaper report saying that a technology that was unveiled at the forum was slated for implementation by a chemical company in Japan.

In succession on October 3, the Committee invited the Fraunhofer, a representative research institute in Germany in the European region, and held the Second International Interchange Forum. Participants in the forum included five persons from Fraunhofer and approximately 40 persons, mostly members of the research institute. Fraunhofer comprises 62 research centers with a workforce of 23,000 persons. It is a gigantic research organization boasting a total budget of 2 billion euro, with a well-balanced portfolio consisting one-third each of government and publically funded projects and contracted research work from the industrial sector. After an introduction of the entire research institute, a detailed presentation was made regarding the materials development (nano-carbon and a freezer using an adsorbent) that the institute is pursuing in a joint industry and academia effort. Many questions were asked on functional materials made with a two-dimensional array of graphene and carbon nanotubes. Ms. D. Kaske (Business Development Manager Asia, Fraunhofer Headquarters/Fraunhofer Representative Office Japan) of the institute made a presentation on the possibility of forming ties with Japanese chemical industry. It is hoped that through the forum, new tie-ups will come into being as we move forward.

Both forum events were well-received, with the participation of a broad spectrum of fields encompassing special-member groups and the planning and industry-academia coordination divisions of member corporations. For the next meeting, we are planning to offer lectures from regions different from those covered in the recent events. (Photos: from the Second Forum).

For further details on the International Interchange Forum, please visit the JACI website "Featuring past events/forums".
Forum 1 https://www.jaci.or.jp/event/event_apply.php?event_id=398
Forum 2 https://www.jaci.or.jp/event/event_apply.php?event_id=444

GSC Topic

Aiming for realization of KAITEKI
– Bio-based transparent engineering plastics DURABIO®

Takashi Komaya, General Manager, Sustainable Resources Dept., Polymer Div., Mitsubishi Chemical Corporation

As a core company among the Mitsubishi Chemical Holdings Corporation, Mitsubishi Chemical Corporation has conducted wide-ranging business initiatives for the realization of KAITEKI through corporate activities, focusing on “Sustainability [Green]” (Environment and Resources) , “Health” and “Comfort” as decision criteria for corporate activities. This paper describes the bio-based transparent engineering plastic DURABIO®, which is a polymer material contributing to the solution to the problem of resource depletion, and adding to enhanced comfort in our lives, thanks to its unique performance characteristics.

1. Mitsubishi Chemical Holdings “KAITEKI Management”

The Mitsubishi Chemical Holdings Corporation (MCHC) Group is aiming to realize KAITEKI through its corporate activities with the three decision criteria of sustainability, health and comfort. KAITEKI is an original concept of the MCHC Group that signifies “a sustainable condition which is comfortable for people, society and the Earth, transcending time and generations.”

Aiming for realization of KAITEKI since April 2011, the MCHC Group has adopted a new kind of management that we call “KAITEKI Management.” This consists of three types of management. Two of these are, “management with a focus on capital efficiency” (MOE: Management of Economics) and “management that strives to create innovations for society” (MOT: Management of Technology) . The third management approach is “management that aims to improve sustainability” (MOS: Management of Sustainability) .

We seek to increase the corporate value that these types of management generate.

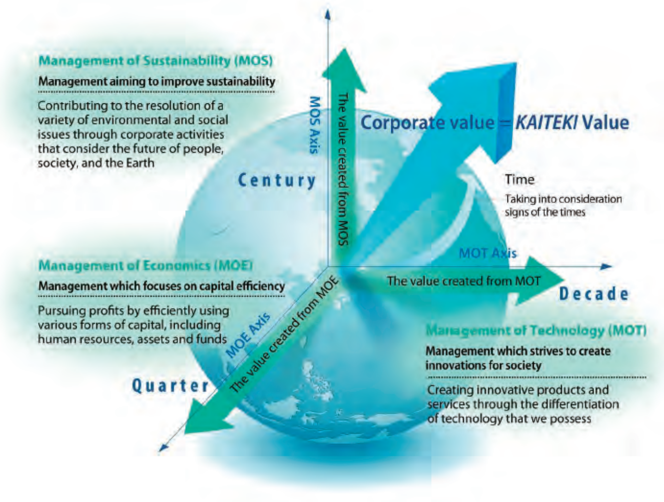


Fig. 1 Three axes of KAITEKI management

2. Transparent, bio-based engineering plastic DURABIO®

Mitsubishi Chemical Corporation has developed the transparent engineering plastic DURABIO®, which is a bio-based material made with renewable resources as a primary material contributing to the “realization of KAITEKI.”

In addition to offering attractive performance characteristics as glass substitutes, including a high transparency and excellent optical properties, DURABIO® also shows superior scratch resistance, excellent weather resistance and high impact resistance. A polymer design that fully exploits the unique structure (heterocyclic secondary diol) of isosorbide gave birth to an innovative material offering performance characteristics that are impossible to achieve with conventional transparent plastics.

From a “Sustainability [Green]” (environment, resources) standpoint and compared with conventional polycarbonates, DURABIO® can reduce the volume of consumption of exhaustible resources used by 60%, and the volume of CO_2 emissions derived from exhaustible resources by 40% per ton of the polymer in terms of production to final disposal. In addition, for the source of carbonate, Diphenyl Carbonate (DPC) is used for the melt-polymerization process which is proprietary to Mitsubishi Chemical. Because the process does not require any use of solvents such as methylene chloride, it can substantially reduce risks to the environment. Also, by recycling the phenol that is generated as a reaction by-product from DPC, we have achieved a completely closed-loop production cycle.

From a “Comfort” standpoint, addressing the demand for “lightweight, thin and fracture-resistant” in display applications, we have proposed several applications of glass substitute components and ultra-thin optical films using DURABIO®. Furthermore, in response to “paint-less application” needs in automotive interior parts, we are working jointly with automotive manufacturers on the commercialization of mold-in colored materials by exploiting the superior surface scratch resistance, brightly-colored appearance and designing process with the freedom of DURABIO®.

At Mitsubishi Chemical Corporation, a commercial-scale production plant for DURABIO® has been in operation at the Kurosaki factory since 2012, searching for new markets and applications of DURABIO® by working together with our customers. As a consequence, DURABIO® has been adopted in many applications, and has achieved the results in reducing the volume of consumption of exhaustible resources, reducing the volume of CO_2 emissions and minimizing the environmental impact. As we move forward, we would like to further develop the new applications and markets for DURABIO®, promote the realization of KAITEKI and expand our contributions to Green Sustainable Chemistry.

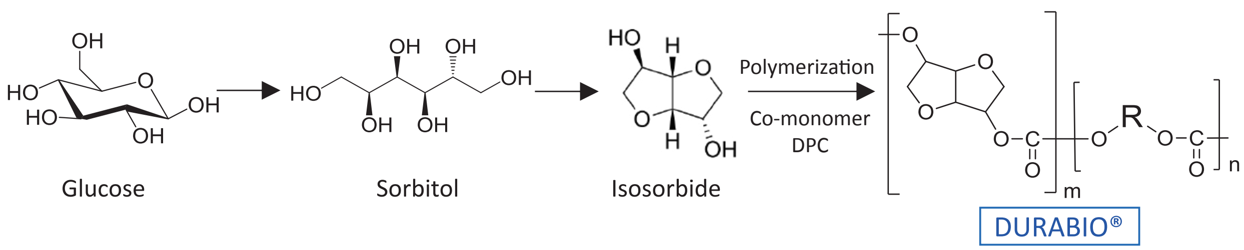


Fig. 2 Structure of DURABIO® and its manufacturing route

Novel Organic Synthetic Method with Micro and Nanobubble Based Strategy

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The micro- and nanobubble (MNB) is defined as a fine bubble ranging in size from tens of micrometers to hundreds of nanometers in diameter. MNB has properties different from the common-variety bubble of several hundred micrometers or greater in diameter. Until now, the MNB has been an object of research in fluid mechanics, environmental engineering and fisheries. Until the year 2010, however, there had not been any research papers describing the use of the MNB in synthetic organic chemistry. What makes the MNB an interesting topic of research? Can it really work in organic synthesis? Can it be applied at the industrial level beyond the laboratory level? To answer these questions, this paper describes the background that led to the development of an environmentally-friendly gas – liquid – (solid) phase organic synthesis process from Shizuoka.

"Manufacturing" using gas phase – liquid (– solid) phase reactions as a key feature has evolved from a laboratory curiosity to industrial-scale implementation. However, because the solubility of the gas phase in the liquid phase is low, in many cases the reaction requires vigorous mixing under high pressure in a pressure-resistant vessel (Fig. 1 – conventional process). As a result, despite the fact that gas-liquid phase reactions are simple and clean by nature, they are often seen as something to be avoided from safety and cost standpoints. The key question to be answered in solving these issues is how to simply and efficiently disperse and dissolve the difficult-to-dissolve gas into the liquid phase. In this project, using an MNB that has properties greatly different from ordinary bubbles (extremely slow speed of rise, large specific surface areas and a fast rate of dissolution), we developed a next-generation gas phase – liquid (– solid) phase synthesis process and apparatus from Shizuoka. (Fig. 1 – MNB method)

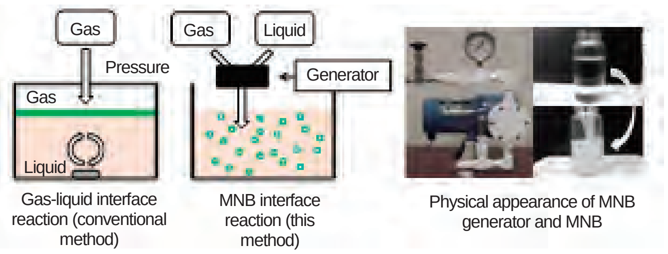

Fig. 1. Gas-liquid phase reaction and MNB generating system

Because commercially available large-scale water MNB generating units are not suitable for laboratory-level organic synthesis, in 2009 we fabricated a small-scale microbubble generator suitable for organic synthesis, collaboratively with Asupu Corporation based in Shizuoka Prefecture (Fig. 1). Using this apparatus capable of rapidly rendering the oxygen concentration to a supersaturation, we studied the aerobic oxidation reaction of primary alcohol. The results indicated a rapid quantitative progression of the reaction (Fig. 2). Also, the required amount of gas was small (3-5 mL/min) in relation to the overall flow rate (120 mL/min). By contrast, ordinary bubbling or open systems failed to complete the reaction. These features appear to derive from the new process's ability to maintain the solute gas concentration in a saturation state, ensuring that even when the solute gas is consumed, the MNB existing in the liquid phase continues to dissolve.

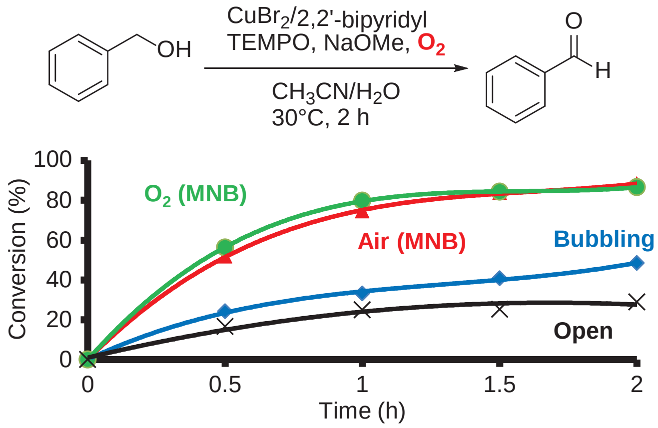

Fig. 2. Aerobic oxidation of alcohol by a Cu/TEMPO catalyst

The MNB method can be extended to organic reactions and the synthesis of beneficial substances, including (1) the aerobic oxidation reaction of secondary alcohol, (2) the hydrogen reduction of alkene or nitroarene, (3) the one-pot synthesis of hydrogen peroxide by the anthraquinone method, and (4) oxidation reactions using photo-excited singlet oxygen (Fig. 3). In particular, in the oxidation process using singlet oxygen, the reaction proceeds even in the absence of a sensitizer, and thus enables the construction of highly clean reaction systems. From the history of the apparatus development process, we believe that the apparatus can be scaled up with relative ease.

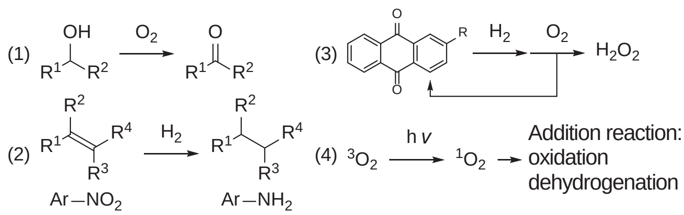

Fig. 3. Various organic synthetic reactions using the MNB method

As this method is pursued, we expect the widespread use of the MNB method as an efficient organic synthesis system in gas phase – liquid (– solid) phase reactions.

JACI activity publicized at the JAIMA forum

For three days on September 3-5, the Japan Analytical & Scientific Instruments Show (JASIS) was held at Makuhari Messe, drawing 24,000 attendees.

The event featured a program entitled "The Chemistry Supporting Modern Society and Its Future," sponsored by the Japan Analytical Instruments Manufacturers' Association (JAIMA). Representing JACI, Akira Igarashi, Director of Business Programs, gave a lecture and described the objectives of the Association and its activities. The lecture attracted an audience of about 60 people, and a question and answer session was held after the lecture.

Being wide open to a variety of opportunities, JACI proactively conducts PR activities to make the programs of the Association known to a broad spectrum of chemistry constituencies and it is working diligently to strengthen ties with the various organizations.

July 2015
4th JACI/GSC Symposium
7th GSC International Conference in Tokyo

Sign-ups for event attendance will be accepted beginning in November

◇ When:

July 5-8, 2015

◇ Where:

Hitotsubashi Auditorium, Hitotsubashi University (Takehashi, Tokyo)

◇ Main theme:

"For the further development of GSC"

◇ Scheduled lecturers:

Makoto Misono, professor emeritus, the University of Tokyo; Kazuhito Hashimoto, professor, the University of Tokyo; Osamu Kobayashi, professor, the University of Tokyo; Dr. Constable, ACS GCI; M. Hearn, professor, Dr. Cefic Klots, Monash University; K.Matyjaszewski, professor, Carnegie Mellon University; W. Leitner, professor, the RWTH Aachen University; Y.W.Lee, professor, Seoul University; and others

The GSC International Conference is to be held in Tokyo for the first time in 12 years after the first meeting was held in Japan in 2003.

Aiming for the further growth of GSC, the conference invites leaders in industry, academia and government in various countries and regions throughout the world to present lectures, conduct discussions and provide a forum for research presentations focusing on future commitments and the cutting-edge scientific results in the world.

We are also planning to put on a special session aiming to usher in a new era for GSC. Your support is requested.

Readers are invited to visit the dedicated website, http://www.jaci4gsc7.org, also from the Association home pag.

Editors' Postscript

In this issue, we asked Dr. Makoto Misono to provide a lead essay.

Dr. Misono has agreed to be a keynote speaker at GSC-7 to be held next year.

In retrospect, it was Dr. Minoso who provided a lead essay in the memorable first issue of the *GSCN Newsletter*, which was launched in July 2001.

In the essay, Dr. Misono painted a clear picture of what was lying ahead of us, pointing out that what was critical was an overall evaluation of the level of greenness, by taking a look at the entire spectrum of products and processes, that every individual and group must make a commitment to achieving greenness and that people must proactively disclose information for mutual benefit, cutting across the organizational barriers.

Given the significant changes that have occurred in the environment and future long-term prospects, we eagerly anticipate that in the keynote lecture, for which Dr. Misono is taking the podium in July 2015, 14 years after the first issue of the *Newsletter*, he will unveil new concepts of GSC that are needed now.

Together with active responses for applications for the GSC award, we are hoping for a large turnout at the GSC－7 event.

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