

New Energy and Industrial Technology Development Organization  
Mitsubishi Electric Corporation  
Tokyo Institute of Technology  
Ryukoku University  
Microwave Chemical Co., Ltd.

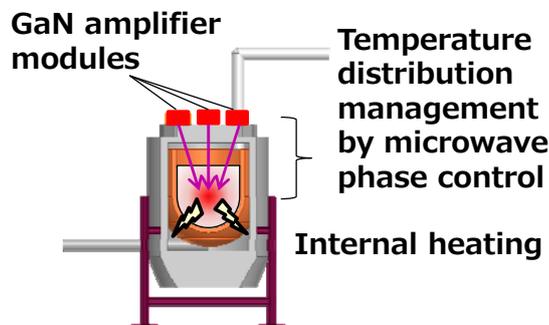
## **Mitsubishi Electric, Tokyo Tech, Ryukoku Univ., Microwave Chemical Develop Microwave Heating System With GaN-amplifier-module Heaters**

*Will contribute to high-level energy saving in chemical industry*

**TOKYO, January 25, 2016** – Mitsubishi Electric Corporation, Tokyo Institute of Technology, Ryukoku University and Microwave Chemical Co., Ltd. announced today their joint development of a microwave heating system that uses 500W-output gallium nitride (GaN) amplifier modules as heat sources. The modules consume 70 percent less energy than conventional external heating systems that use fossil fuel and improve chemical-reaction productivity by three times compared to dispersed heating systems. Practical uses will now be developed for high-level energy saving in the chemical industry.

Whereas external heating systems consume high amounts of energy because they need to heat both the equipment and the chemicals inside, the new internal heating system saves energy consumption by heating the chemicals only. In addition, the system adopts a new method that controls the microwave phases generated by the modules and thereby manages temperature distribution, leading to greater productivity in chemical-reaction.

GaN devices offer more power density and power efficiency than silicon (Si) or gallium arsenide (GaAs) devices. GaN amplifier modules are expected to help reduce the size of communication equipment, radars and other equipment for general industry.



**Microwave heating equipment employing GaN amplifier modules  
as heat sources**

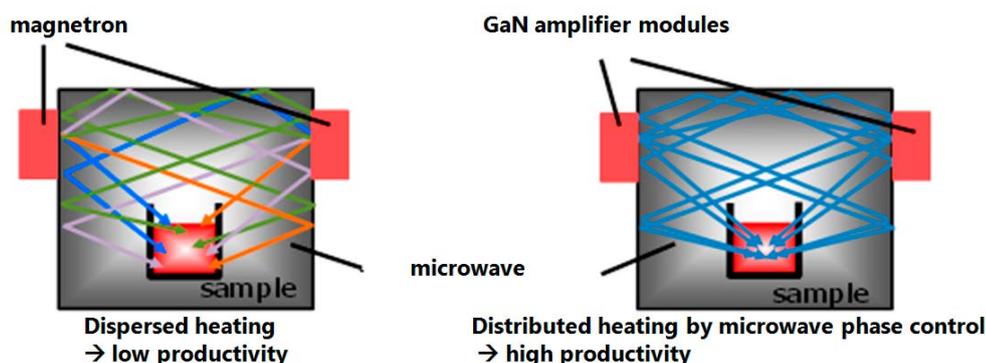
## Performance Comparisons

	Heating System	Heat Source	Heating Type	Energy Consumption*	Productivity*
New System	Internal	GaN amplifier module	Distributed	0.3	3
Current System	Internal	Magnetron	Dispersed	0.3	1
	External	Fossil fuel	Dispersed	1	—

\* Current system = 1



**New GaN amplifier module**



## Respective Responsibilities

Mitsubishi Electric Corporation

- Production of GaN devices
- Development of microwave GaN amplifier modules

Tokyo Institute of Technology

- Selection of sample chemicals
- Verification of chemical-reaction productivity and fundamental evaluation for improvements
- Standardization

Ryukoku University

- Design of microwave GaN amplifier modules
- Fundamental research to improve microwave heating system efficiency

Microwave Chemical Co., Ltd.

- Increasing size of testing reactor containing microwave heating system employing GaN amplifier modules as heat sources
- Evaluation of energy saving outcomes

Development was conducted under a public project, named Clean Device Promotion Project / High efficiency High Power Microwave GaN Amplifiers Realizing Energy-Saving Society, which is aimed at facilitating novel applications of innovative electronic devices through demonstration and standardization. The project was commissioned by the New Energy and Industrial Technology Development Organization (NEDO), an independent administrative agency of Japan.

**Media Inquiries**

**Mitsubishi Electric Corporation**

Public Relations Division

Tel: +81-3-3218-2332

[prd.gnews@nk.MitsubishiElectric.co.jp](mailto:prd.gnews@nk.MitsubishiElectric.co.jp)

<http://www.MitsubishiElectric.com/news/>

**Tokyo Institute of Technology**

Center for Public Affairs and Communications

Tel: +81-3-5734-2975

[media@jim.titech.ac.jp](mailto:media@jim.titech.ac.jp)

<http://www.titech.ac.jp/english/index.html>

**Ryukoku University**

Tel: +81-75-645-7882

<http://www.ryukoku.ac.jp/english2>

**Microwave Chemical Co., Ltd.**

Tel: +81-6-6170-7595

[info@mwcc.jp](mailto:info@mwcc.jp)

<http://mwcc.jp/en/>

**New Energy and Industrial Technology Development Organization**

Electronics, Materials Technology and Nanotechnology Dept.

TEL:+81-44-520-5221 FAX:+81-44-520-5221

Project Coordinator

Hiroaki Kurihara

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### **About Mitsubishi Electric Corporation**

With over 90 years of experience in providing reliable, high-quality products, Mitsubishi Electric Corporation (TOKYO: 6503) is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, energy, transportation and building equipment. Embracing the spirit of its corporate statement, Changes for the Better, and its environmental statement, Eco Changes, Mitsubishi Electric endeavors to be a global, leading green company, enriching society with technology. The company recorded consolidated group sales of 4,323.0 billion yen (US\$ 36.0 billion\*) in the fiscal year ended March 31, 2015. For more information visit:

<http://www.MitsubishiElectric.com>

\*At an exchange rate of 120 yen to the US dollar, the rate given by the Tokyo Foreign Exchange Market on March 31, 2015

### **About Tokyo Institute of Technology**

As one of Japan's top universities, Tokyo Institute of Technology seeks to contribute to civilization, peace and prosperity in the world, and aims at developing global human capabilities par excellence through pioneering research and education in science and technology, including industrial and social management. Tokyo Tech has an eye on educating highly moral students to acquire not only scientific expertise but also expertise in the liberal arts, and a balanced knowledge of the social sciences and humanities, all while researching deeply from basics to practice with academic mastery. Through these activities, we wish to contribute to global sustainability of the natural world and the support of human life.

<http://www.titech.ac.jp/english/>

### **About Ryukoku University**

Ryukoku University was established as a Buddhist seminary called "Gakuryo" (Boarding School) in the precincts of Nishi-Hongwanji Temple by its 13th abbot, Ryonyo, for the promotion of research and Shin Buddhism education. Being older than Shoheiko, the official Edo Shogunate school, Ryukoku is one of the oldest institutions of higher education in Japan.

<http://www.ryukoku.ac.jp/english2>

### **About Microwave Chemical Co., Ltd.**

Microwave Chemical was established as a venture company originated from National University Corporation Osaka University. Making use of microwave technology, Microwave Chemical aims to bring about revolutions in manufacturing processes of chemical products and promote energy conservation in factories worldwide. Setting "Change the way we produce fuel and chemicals." as its basic concept, Microwave Chemicals starts up and runs many joint projects with companies, laboratories, government institutions, and other organizations engaged in manufacturing, and promotes practical use and industrial application of innovative fruits of these projects.

<http://mwcc.jp/en/>

### **About New Energy and Industrial Technology Development Organization**

NEDO, (abbreviation of New Energy and Industrial Technology Development Organization) was originally established as a semi-governmental organization on October 1, 1980 and reorganized as an Incorporated Administrative Agency on October 1, 2003. NEDO conducts various activities focusing on research and development related to oil alternative energy technology, technology for the efficient use of energy, and industrial technology. Its programs and projects include the promotion of private sector participation in national technology development projects, support for the private sector's own research and development efforts and dissemination of newly developed technology. All of these activities are carried out in a concerted and internationally coordinated manner. NEDO endeavors to ensure a stable and efficient supply of energy under fluctuating domestic and international socio-economic conditions and to assist in the development of Japan's economy and industrial sector. At the same time, NEDO strives to contribute to the fulfillment of Japan's Kyoto Protocol commitment without overly restricting energy use and industrial activities in Japan through, for example, obtaining emission credits via the Kyoto Mechanisms.