

# Micro Device Center Yamatake Corporation

## 1. Challenge of Micromachine Technology

We have been developing business operations with the aim of improving the energy and resource efficiency in buildings, plants, and factories under the visionary slogan "Providing Greater Comfort for People and the Earth." To achieve our business goals, sensing and control technologies are essential. Hence, we have placed emphasis on microelectromechanical systems (MEMS) for developing miniature, high-performance sensors and actuators to be installed on the ends of measuring devices in the field.

We first tackled micromachine technology with the inauguration of our corporate research center in the middle of 1980. Since then, we have established a business partnership with Honeywell Inc. (U.S., now Honeywell International Inc.) for the purpose of researching and commercializing micromachine technology. Today, we are taking on both R&D and fabrication of microdevices, from sensor elements to packages, and are functioning as an organization capable of making microdevices for in-house use available commercially through divisions products. Since it requires much time and effort to discover new products and businesses with marketability, a separate organization has been created in the Research & Development Headquarters to perform exploratory seeds development function.

## 2. Development of Micromachine Technology

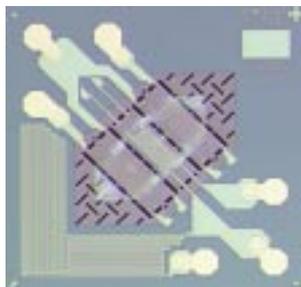
Here, we will introduce some of the microdevices we have successfully developed and commercialized.

### 1) Humidity sensors

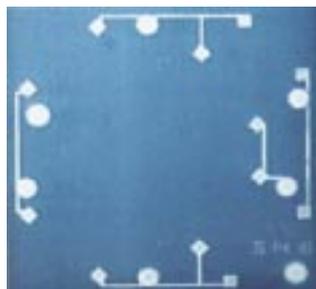
Humidity sensors are next in importance after temperature sensors in terms of controlling the air condition in a building. A stable humidity-sensitive polymer film was developed through joint research with universities conducted over several years, enabling us to develop advanced humidity sensors. Evaluations conducted by an independent Swiss institute revealed that our product is superior to other major humidity sensors in the world in dew point stability and chlorine resistance. Accordingly, Yamatake humidity sensors are being widely employed,



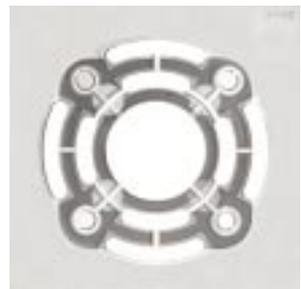
Humidity sensing elements



Microflow sensing elements



Piezo-resistive pressure sensing elements



Sapphire pressure sensing elements



**Shunichiro Awa**  
Director, Micro Device Center

primarily in air conditioning systems for buildings, while increasingly attracting the attention of both national and international users.

### 2) Microflow Sensors

We began full-scale development of thermal flow sensors in the late 1980's, with the aim of applying this knowledge to gas flow measurement. In 1994 we succeeded in mass-producing microflow sensors with 1.7 millimeters square chip. The sensor possesses outstanding features, such as a high sensitivity capable of measuring a flow rate of 1 cm/sec or less. We improved the performance and functionality of the sensor through the production of numerous prototypes and repeated field tests. In addition, we collected and evaluated sensors that had been installed in the field for more than ten years. Then proved the long term reliability of our products. Using this microflow sensor, we have developed a high-speed, high-accuracy flow measurement technology for a wide range of applications, from ultra low flow rates to high flow rates. In addition, many results have been obtained by applying this microflow sensor to studies of flows on wall surfaces.

### 3) Pressure Sensors

The most basic targets of industrial measurements are flow rate and pressure. A pressure sensor measures not only pressure, but also flow rate calculated based on the pressure differential across the diaphragm, or orifice, formed in the piping. The pressure sensor is the oldest MEMS sensor that has been widely used in industrial applications. Yamatake has also conducted intensive research and development since the inauguration of the corporate research center and the Micro Device Center. We successfully developed pressure sensors utilizing piezoresistive pressure sensing elements and marketed them as the world's smallest microprocessor-based pressure sensors. Our primary pressure sensors have high accuracy and high-temperature stability.

In order to meet the demands for pressure measurements under high-temperature and corrosive environments, we developed the Sapphire capacitive sensor that can offer excellent resistance to heat and corrosion. The sensor element is produced from 100% sapphire and can directly measure temperatures of several hundreds of degrees, as well as pressures on corrosive media. Since the development phase, the sensor has received high praise from customers in the fine chemical and semiconductor industries. We hope to accelerate commercialization of this sensor.

## 3. Future Challenges

As described above, humidity, flow rate, and pressure are basic targets of sensing in the

field of measurement and control. We continue to conduct research and development to meet the needs of our customers. In addition, we will employ a comprehensive technology accumulated through the development of in-house microdevices to take a further step toward developing and producing commercial devices for outside customers.