Supplemental Explanation

Supplemental explanation 1 MEMS

In general, micro electro mechanical system (MEMS) is a generic term for devices such as mechanical components, sensors, actuators, electronic circuits and other such devices that integrate various functions and that are fabricated using semiconductor microfabrication technology. In Japan, this field had previously been known as the micro machine field.

To manufacture MEMS devices, various types of materials are processed, typically silicon (Si) wafers, glass wafers and the like. MEMS devices are fabricated using nearly the same equipment as for large scale integrated (LSI) circuit manufacturing, but MEMS specialized equipment is also necessary for such processes as wafer bonding, deep etching to a depth of several hundred microns, and forming three-dimensional shapes or movable structures, which are not used in LSI manufacturing.

Technology for fabricating MEMS structures includes surface micro-machining for forming laminated structures on the surface of Si substrates or the like, and bulk micro-machining which utilizes deep etching technology to process the Si substrate itself and form structures. Until recently, surface micro-machining, which is similar to the technology used in LSI fabrication, had been the more common but with advances in MEMS-specific process technology such as deep etching and wafer bonding, bulk micro-machining has become more widely used.

Examples of typical MEMS devices include acceleration sensors, pressure sensors, ink jet heads, gyroscopes, and so on.

Supplemental explanation 2 Specific energy consumption

The specific energy consumption is the amount of energy usage divided by “a value closely related to production volume, building floor space or the like,” which provides an energy management index. This index was created under the assumption that energy consumption will increase if the production volume or building floor space increases.

Here, “a value closely related to production volume, building floor space or the like” refers, in the case of a plant, to the number or weight of products manufactured, while in the case of a building, the total floor space is often used. A suitable quantity must be used for each plant or workplace.

As an energy savings index for an entire plant, the specific energy consumption is a numeric value obtained by dividing the total amount of energy by the total production volume. In a plant that manufactures many types of products, however, the total plant production volume cannot be expressed with a single quantity. Even with an energy consumption rate for the entire plant, if the energy management attempts to reduce consumption, the constituent elements will have to be retroactively analyzed and thus the specific energy consumption will ultimately be managed separately for each product and process. In addition, assessment of the individual specific energy consumption for fuel, electric power, service water and other types of energy or their applications, and analysis of their relation to production volume, yield and manufacturing equipment performance is necessary.

Supplemental explanation 3 Sequence control and motion control

Sequence control is defined, according to Japan Industrial Standard (JIS), as "control that proceeds sequentially through various stages of control according to a predetermined order or procedure." Sequence control is applied, for example, to equipment such as building elevators and car wash facilities, food product production lines that require automation, and production line equipment at plants that manufacture automobiles or other products for which a series of operations are performed based on operating instructions.

Motion control uses drive equipment such as servo amplifiers and inverters to implement sophisticated synchronous control of the operation of multiple motors. Motion control is applied, for example, to printers that print by overlaying multiple colors and to packaging machines that need to align locations for adhesion, and in steel plants, to rolling mills for forming uniform material thicknesses, and to the control of servo-presses or other equipment at high speed and with high precision.

In actual factory production lines and at steel plants, control systems are typically realized by combining sequence control and motion control. In such cases, sequence control and motion control had each previously been implemented with their own CPU module, but recently, with the improved performance of microcontrollers and other such devices, sequence control and motion control can be implemented with a single CPU module.

Supplemental explanation 4 Drift performance

Drift performance is a performance indicator that also designates stability, and is a key factor in indicating the performance of gas analyzers. Drift performance is typically discussed in terms of zero drift (stability of the zero point) and span drift (stability of the sensitivity corresponding to the concentration proportionate to the measurement range). These quantities are expressed as the ratio of the zero point or span fluctuation versus the measurement range within a fixed period such as a day, a week, a month, and so on. As the measurement range progresses toward lower concentrations, the drift performance deteriorates relatively, and therefore, improvement of the drift performance presents a challenge.

Drift in an infrared gas analyzer is caused by internal and external factors. The internal factors include fluctuations in the infrared light source intensity and detector sensitivity caused by temperature changes and fluctuations in the supplied power, as well as long-term deterioration of the infrared intensity and changes in the detector sensitivity. The external factors include contamination of the sample cell window and walls by contaminants (such as dust or mist) in the measurement gas.