APPLICATION NOTES

Quality control of aluminum alloys by measuring conductivity

Aluminum alloys with various properties are produced by adding additive elements such as magnesium, copper, silicon, zinc, and manganese to aluminum with a purity of 99% or higher. Aluminum alloys have the following advantages: they are lightweight yet strong, can be heat-treated to increase strength, can be cast into various shapes, can be cold-worked for high formability, are highly corrosion resistant, have high thermal conductivity, and are non-magnetic. Taking advantage of these characteristics, it is widely used in parts for aircraft and automobiles.

There are two types of aluminum alloys: non-heat-treatment type and heat-treatment type. Heat-treatable types, in particular, are heat-treated to ensure hardness, which varies with the passage of time after heat treatment. This is called age hardening or precipitation hardening. Precipitation is a phenomenon in which an element dissolved in the matrix phase is formed into another solid phase as the temperature changes. The hardness varies depending on the state of this precipitation.

In the past, mechanical hardness test devices have been used for hardness control at production sites. However, although precipitation state and microstructural changes accompanying heat treatment can be evaluated by microscopic observation, non-destructive testing cannot be carried out on site. Furthermore, it is difficult to evaluate changes in microstructure and crystal structure, such as heat treatment strain and residual stress, using these tests.

On the other hand, since the flow of electricity is generated by the movement of electrons around atoms, the ease of electric flow varies depending on the atomic arrangement and crystal structure.

Measuring conductivity allows us to evaluate not only the state of age-hardening but also the state of microstructure. Conductivity can also be measured using the four-terminal method, but this is not simple and is not suitable for the field.

Figure 1: Conductivity measurement with SIGMATEST

FOERSTER's SIGMATEST 2.070 eddy current conductivity measurement device is compact, lightweight, and portable. This makes it easy for anyone to perform measurements and results are independent of the operators skills. Just apply the probe to the material being tested, and the measured value is displayed and logged on the device. It is a highly reliable measuring instrument with a temperature compensation function.