# §9. Evaluation of Microwave Absorption for Metal Powders by Coaxial Cable Probe Method

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We have been measured dielectric and absorption behaviors of metal powders at microwave and millimeter-wave region. We reported as follows[1). Metal powders such as Fe, Cu and so on absorb microwave power at room temperature. During vacuum heating, the microwave absorbency begins to decrease at certain temperature and became a microwave reflector. However Au powder does not absorb microwave power because Au particles make electrical connections when only slight external pressure was applied.

In this study, we prepared Al powder compact bodies with varying density, and measured complex dielectric constants by means of the coaxial cable probe method.

The measuring system is consist of a network analyzer (Agilent: 8573E) and a coaxial cable probe (Agilent: 85070B), and the complex dielectric constants are measured at a frequency range from 0.2 to 3GHz. Al powder (Wako: 014-01785) is uni-axially pressed and obtained 10mm diameter and 10mm high columnar sample. A flat surface of sample is contact with the tip of coaxial cable probe, and complex dielectric constants are calculated using the dielectric measurement software belong to 85070B. Microwave absorption of metal powder is caused by dielectric loss and resistivity loss, and additionally magnetic loss for magnetic metals. By the coaxial cable probe method, measured dielectric constant is apparent one which includes dielectric loss and resistivity loss. Coaxial cable method is applied for low density samples by using ring shape samples mixed with polyethylene (almost zero loss material) which dimensions are 7.0mm outer diameter, 3.2mm inner diameter and 1.0mm thick.

By changing uni-axial pressing force from 25 to 125MPa, we obtained compacted samples with apparent density from 63 to 80%. Surface resistivity of the highest density sample was enough high, it means Al particles are separated with surface oxide layer and they insulate each other electrically. Therefore, they absorbs microwave power as compacted

Fig. 1. shows appearance of the coaxial cable probe and an Al powder compact sample. Place the measuring surface at upper side of the coaxial cable probe, and put an Al compact sample, we can measure dielectric constant stably.

Fig. 2. shows measurement result of dielectric constant (real part) at 2.45GHz for Al powder with varying apparent density. Measurement result for low density samples measured by coaxial cable method at 10GHz is plotted in the same figure. From this figure, it is obvious

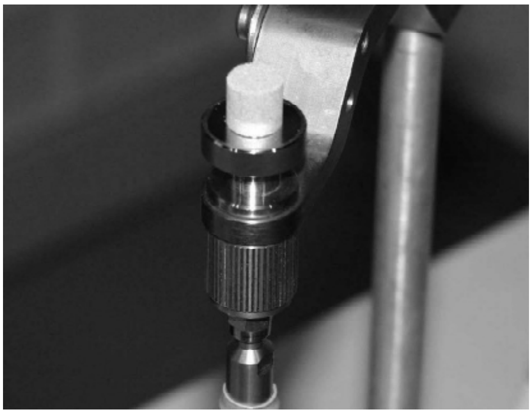

Fig. 1. Appearance of coaxial cable probe and metal powder compact sample.

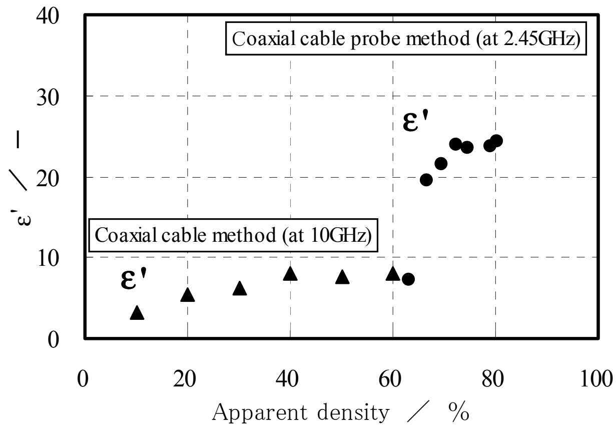


Fig. 2. Dielectric constant (real part) of Al powder with varying apparent density.

that dielectric constant at apparent density above 65% is over 2 times bigger than that at apparent density below 65%. Similar tendency was observed for imaginary part of dielectric constant. This result agrees with the result of computer simulation by Ignatenko and Tanaka, they reported dielectric constant of metal powder drastically changed at a certain density.

1) Sano, S. et al.: ANNUAL REPORT of NIFS, April 2009 – March 2010 (2010) 440.