

coil turn number and the distance between the wires remain constant, the inductance value will decrease with the increasing wire width. Moreover, the curve of the inductance keeps a relatively stable trend, and the deviation between the test inductance and theoretical inductance is between 5% and 12%. These issues above are all worthy of further research.

B. Experimental test of the impedance model

When alternating current circulates in the micro-planar coil, alternating magnetic field will generate around the coil. The eddy current effect can also be reflected by the signal of impedance^[7]. So the impedance is another expression of the inductance.

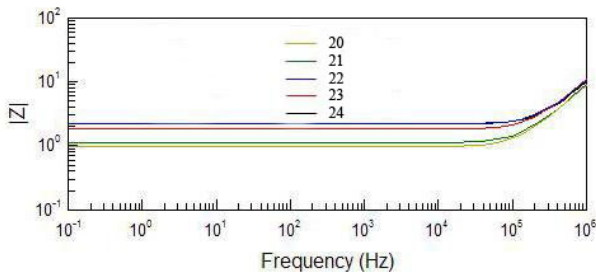


Figure 6. The relationship between impedance and frequency of the first group of coils

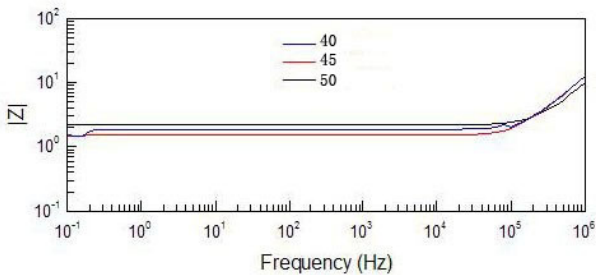


Figure 7. The relationship between impedance and frequency of the second group of coils

In order to verify the impedance model, we use Solartron Electro-chemical impedance system. The two groups of coils which are tested in the previous experiment are also used in this experiment. Give an excitation voltage of 10mV to the

coils, and the frequency incentives from 1MHz to 0.1Hz. Then we can get the relationship between the impedance value and the frequency.

Fig.6 and Fig.7 are the relationship between impedance and frequency. The curves of the impedance in Fig.6 and Fig.7 are similar. The impedance starts to be stable when the frequency is about 5×10^4 MHz. When the excitation frequency is between 5×10^4 MHz and 0.1Hz, the impedance is extremely stable.

V. CONCLUSION

According to the above theoretical analysis and experimental validation of the mathematical model of the micro-planar coil, the inductance and impedance can well describe the near-field eddy current effect of the micro-planar coil. But the inductance model has a more strong computability, and the theoretical result is consistent with the experimental results. The deviation of the inductance between the test results and theoretical results is between 3% and 12%. So the deviation is in an acceptable range, while it can be detected by Agilent 4294A Precision Impedance Analyzer.

This paper can be a foundation of micro-planar coil for eddy current nondestructive testing. It provides an approach and mathematical foundation to the micro-planar coil for applying in the oil detection depending on the stability and sensitivity of the micro-planar coil.

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