Application and Study on SQUID Nondestructive Evaluation by Transfer Coil

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ABSTRACT

Superconducting Quantum Interference Device (SQUID) with the unique magnetic characteristics and ultra-high sensitivity combines the differential type of eddy-current probe to apply in the nondestructive evaluation of metal conductor. The study finds out the resonance frequency of the entire excitation coil, sensing coil, SQUID by SQUID as signal amplifier and the design of quad excitation and differential probe. And we utilize best parameter conditions to fabricate the complete system including Dewar, magnetically shielding box, and coils. Consequently it is used to measure some characteristics and to create two dimensional images. In order to improve the practicability and convenience of SQUID application to NDE system, we utilize transfer coil to make induced current flow into magnetically shielding box. It results in the occurrence of magnetic field in the input coil for SQUID sensing.

Keywords : Superconducting Quantum Interference Device， Non-destructive testing， Differential eddy current probe.

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REFERENCES

[1] Yoshihiro Nonaka, “ A Double Coil Method for Simultaneously Measuring theResistivity, Permeability, and Thickness of a Moving Metal Sheet, ” IEEE Trans.Inst.& Measurement, vol. 45, no. 2, pp. 478-482, 1996.

[2] 李家傳，陳積懋，無損檢測手冊，北京:機械工業出版， 2002。

[3] C. C. Tai, J. H. Rose, and J. C. Moulder, “ Thickness and Conductivity of MetallicLayers from Pulsed Eddy Current Measurements, ” Rev. Sci. Instrum,vol. 67, pp. 3965-3972, 1996.

[4] W. G. Jenks, S. S. H. Sadeghi, and J. P. Wikswo, Jr., “ SQUIDs for Non-DestructiveEvaluation, ” J. of Physics D: Appl. Phys., vol. 30, pp. 293-323, 1997.

[5] 李冠勳, “ 差動式渦電流探頭於缺陷偵測之最佳激發頻率研 究 ”,國立台北科技大學製造科技研究所碩士論文,2005 [6] J. B. Hull, and V. B. John, Non-destructive testing, London: MacMillanEducation LTD., 1988.

[7] 徐智魁, “ 高溫超導量子干涉元件一階梯度計之製作與特性 研究 ”,國立台灣師範大學光電科技研究所碩士論文,2005 [8] J. T. Jeng, H. E. Horng, and H. C. Yang, “ High-Tc SQUID magnetometers andgradiometers for NDE application, ” Physica C, vol. 368, pp. 105-108, 2002.

[9] Jen-Tzong Jeng, Guan-Shiun Lee, Hsin-Chin Hung, Ju-Chien Chen, Wen-SungChiou, Li-Lun Chen, Ji-Cheng Chen, Chiu-Hsien Wu, Hong-Chang Yang, and H. E.Horng, Proc. of 6th European Conference on Applied Superconductivity(EUCAS 2003), Sorrento, 2003.

[10] Tadayuki Kondo and Hideo Itozaki, “ Normal conductingtransfer coil forSQUID NDE ”, Supercond. Sci. Technol. 17.pp 459 – 462, 2004.

[11] 鄭振宗, “ 直流高溫超導SQUID的特性及其在非破壞性檢測 上之應用 ”,國立台灣師範大學物理研究所博士論文,2001 [12] 物理會刊 ， 5 卷4 期, P.189-193 (1984) [13] 物理雙月刊,24卷5期,P652-665,2002 年10 月 [14] Akihiko KANDORI, Daisuke SUZUKI, Koichi YOKOSAWA, Akira TSUKAMOTO,Tsuyoshi MIYASHITA, Keiji TSUKADA and Kazumasa TAKAGI, “ A Superconducting Quantum [15] D F He ,H Itozaki and M Tachiki1, “ Improving the sensitivity of a high-Tc SQUID at MHz frequency using a normal metal transformer ”,

Supercond. Sci. Technol. 19, S231 – S234, 2006.
[16] W G Jenksy, S S H Sadeghiz and J P Wikswo Jry, “ REVIEW ARTICLESQUIDs for nondestructive evaluation ”, J. Phys. D: Appl. Phys. 30,pp. 293 – 323, 1997.
[17] John P. Wikswo, Jr., “ SQUID Magnetometers for Biomagnetism andNondestructive Testing: Important Questions and Initial Answers, ” IEEE Trans.Appl. Supercond., vol. 5, No. 2, pp. 74-120,1995.
[18] H. Fukutomi, T. Takagi, and M. Nishikawa, “ Remote field eddy current techniqueapplied to non-magnetic steam generator tubes, ” NDT&E International, vol. 34, pp. 17-23, 2001.
[19] C. Rem, E. M. Beunder, and A. J. van den Akker, “ Simulation of Eddy-CurrentSeparators, ” IEEE Trans. on Magnetics, vol. 34, no. 4, pp. 2280-2286, 1998.