

# SQUID 非破壞性檢測系統研究

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## 摘要

中文摘要 超導量子干涉元件(Superconducting Quantum Interference Device, 簡稱SQUID)是目前所知最敏感的磁通偵測器,可偵測到10-14至10-15 Tesla的訊號,約為地磁十億分之一,其獨特的磁通與電壓的週期特性,使得SQUID已被使用在精密量測,成為微弱物理量如磁場、磁場梯度、電流、電壓、電阻、電感及磁化率等測量上最靈敏的感測元件。而本文利用渦電流(eddy current)檢測法配合線圈(coil)探頭與SQUID磁量計(magnetometer)對金屬導體進行非破壞性檢測(nondestructive evaluation)。本實驗中我們自行設計研發整套系統,其內容包括杜爾瓶(Dewar)、屏蔽桶(magnetically shielding box),與線圈的製作及特性量測等。我們利用G-10等級的玻璃纖維(fiberglass)作為杜爾瓶的材料,因為它具有熱膨脹係數小與低溫不裂開的特性,所以加工成為我們系統中盛裝液態氮(liquid nitrogen)的保溫容器。在屏蔽桶的製作上,我們使用mu-metal抵抗地磁與各種低頻的雜訊,並配合銅網與鋁板阻擋高頻的電磁波,讓我們的屏蔽效應達到高水準的要求。為了增加系統的實用性與便利性,我們設計激發線圈(excitation coil)與感應線圈(pick-up coil)作為梯度計(gradimeter)探頭,而探頭可以遠離SQUID,只要將感應電流經由傳輸線傳回屏蔽桶內並讓二次激發線圈(input coil)產生磁場,讓SQUID感應,即可達到缺陷訊號的讀取。

關鍵詞: 超導量子干涉元件; 磁量計; 渦電流; 梯度計

## 目錄

目錄 封面內頁 簽名頁 授權書.....	iii	中文摘要.....	iv
.....iv 英文摘要.....	iv	.....vi 誌謝.....	vi
.....viii 目錄.....	viii	.....ix 圖目錄.....	ix
.....xi 第一章 緒論 1.1 研究背景與動機.....	xi	1.2 文獻回顧.....	1
.....2 第二章 實驗方法 2.1 渦電流檢測法.....	2	2.2 實驗設計與架構.....	3
.....6 第三章 系統設計 3.1 杜爾瓶.....	6	3.2 超導量子干涉元件.....	8
.....14 3.2.1 探針(Preobe)設計.....	14	3.3 屏蔽系統.....	21
.....25 3.4 探頭系統.....	25	3.3.1 屏蔽桶屏蔽係數量測.....	25
.....30 3.4.1 平面式線圈梯度計原理與製作.....	30	3.3.2 LabVIEW 人機介面.....	31
.....44 3.5 量測系統與人機介面.....	44	3.5.1 二維滑軌平台(X-Y table).....	45
.....46 第四章 實驗結果與討論.....	46	3.5.2 LabVIEW 人機介面.....	46
.....52 第五章 結論.....	52	.....48 第五章 結論.....	48
.....53 參考文獻.....	53	.....53 參考文獻.....	53

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