

# 微機電螺旋電感整合鎳鐵-陽極氧化鋁奈米複合物之 製成以及特性

學生：陳冠名

指導教授：鄭裕庭 教授

國立交通大學電子工程學系暨電子研究所碩士班

## 摘 要

在這篇研究當中提出了一個具有懸浮狀微機電式結構的單晶片螺旋電桿整合鎳鐵(鎳占 83%,鐵占 17%)-陽極氧化鋁奈米複合物之製造過程以及其特性,其中我們已經可以成功的在矽基板上將直徑 60~70 奈米的鎳鐵奈米柱經由電鍍的方式將其置入在陽極氧化鋁模板內,對一個三圈半的電感而言,利用鎳鐵磁性柱來提升感值已達到約 16%的增強並持續增強到 1GHz,但卻伴隨著品質因子下降約 55%以及電感自身的共振頻率移向低頻這兩個問題,產生的原因在於用來當種晶層的鈦所產生的大寄生電容效應,為了要降低這層鈦所帶來的效應以及提升品質因子,一道利用氟化氫氣體の後製程在此被引入來等向性移除電桿下方的矽基板使的鈦層可以露出來,接著再利用濕蝕刻的方式來把這層暴露出來的鈦移除掉,從實驗結果來看,利用這個方法可以成功的將品質因子增強到幾乎快跟不加磁性材料時的電感一樣好,並且可以觀察到共振頻率有往後增加了將近 8GHz。

# **Fabrication and Characterization of the Micromachined Inductor with NiFe-AAO Nanocomposite Core**

Student : Kuan-Ming Chen

Advisor : Dr. Yu-Ting Cheng

Department of Electronics Engineering & Institute of Electronics  
National Chiao Tung University

## **Abstract**

This study presents the fabrication and characterization of spiral inductors which is a suspended MEMS structure with NiFe(83 at% Ni and 16 at% Fe)-AAO nanocomposite core. The NiFe nanorods with 60~70nm diameter are electroplated and isolated in AAO(Anodic Aluminum Oxide) template on a silicon substrate. For a spiral inductor with a NiFe-AAO nanocomposite core, about 14% inductance improvement can be observed up to 1 GHz for a 3.5 turn NiFe-AAO inductor, but also accompanied with ~55% Q factor reduction and the resonance frequency shifts toward a low frequency regime due to the parasitic capacitance caused by Ti seed-layer. In order to reduce the effect of Ti layer and improve the Q factor, a post-process using XeF<sub>2</sub> is employed to remove the silicon substrate underneath the inductor isotropically and then to remove the Ti layer by wet etching process. The experimental results show that maximum Q factor can successfully be improved as good as the one with the air-core spiral inductors, and about 8 GHz increase in self-resonance frequency can also be observed.

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# Contents

摘要.....	i
Abstract.....	ii
致謝.....	iii
Content.....	iv
Figure Captions.....	v
Table Captions.....	vi
<b>Chapter 1 Introduction.....</b>	<b>1</b>
1.1 Motivation.....	1
1.2 Historical Review.....	5
<b>Chapter 2 The Synthesis of the NiFe-AAO Nanocomposite and The Fabrication of Micromachined Spiral Inductors.....</b>	<b>9</b>
2.1 Design of the Spiral Inductor.....	9
2.2 The Synthesis of NiFe-AAO Nanocomposite.....	12
2.3 MEMS Strucrure Inductor Imcoporated with NiFe-AAO Nanocomposite .....	20
<b>Chapter 3 Result and Discussion.....</b>	<b>16</b>
3.1 The Characterization of NiFe-AAO Nanocomposite.....	25
3.2 The Performance Measurement of MEMS Inductor Combining NiFe-AAO Nanocomposite.....	28
<b>Chapter 4 Conclusion and Future Work.....</b>	<b>43</b>
4.1 Conclusion.....	43
4.2 Future Work.....	43
<b>Reference.....</b>	<b>44</b>
<b>Vita.....</b>	<b>47</b>

# Figure Captions

## Chapter 1

Fig. 1-1-1: The development of ferromagnetic inductor.....	1
Fig. 1-1-2: The first case of the eddy current loss, while the underlying ferromagnetic material is in the shape of cylindrical with $r=a$ .....	2
Fig. 1-1-3: The second case of the eddy current loss, while the underlying ferromagnetic material is in the shape of N isolated cylindrical with $r=b$ .....	3
Fig. 1-2-1: The equivalent series inductance(a) and Quality factor(b) of Ni-AAO inductor which is designed with $n=3.5$ , $d_{in}=100\mu m$ . .....	6
Fig. 1-2-2: The equivalent series inductance(a) and Quality factor(b) of NiFe-AAO inductor which is designed with $n=3.5$ , $d_{in}=100\mu m$ . .....	7
Fig. 1-2-3: The geometry of the MEMS structure inductor with NiFe-AAO nanocomposite core .....	8

## Chapter 2

Fig.2-1-1. The spiral inductor design is shown in (a) and (b), and the total simulated condition of a air-core inductor is shown in (c) .....	10
Fig.2-1-2. Both simulated results including inductance value and Quality factor are shown in (a) and (b). The simulated magnetic field distribution is plotted in (c). .....	6
Fig.2-2-1. The anodization experiment setup diagram .....	13
Fig.2-2-2. The schematic diagram of the chemical reactions during the	

anodization is shown in (a), and the pore status with respect current is depicted in (b)	14
.....	14
Fig.2-2-3 SEM pictures of the top view and the cross section view of the as-fabricated AAO template, and in (b), there is a barrier layer formed after the anodic reaction which is about 50nm in thickness	15
.....	15
Fig. 2-2-4. The process flow of synthesizing NiFe-AAO starts with depositing Ti/TiN/Al on silicon substrate.....	18
Fig. 2-2-5: The SEM micrograph promote the (a) top view and (b) cross section view of NiFe nanorods. ....	19
Fig. 2-3-1. The process flow of micromachined inductor incorporated with NiFe-AAO nanocomposite.....	22
Fig. 2-3-2. The SEM photograph of (b)as-fabricated MEMS NiFe-AAO inductor. The silicon cavity underneath the nanocomposite is about 140 $\mu\text{m}$ in depth.	24
.....	24
<b>Chapter 3</b>	
Fig. 3-1-1: The M-H loops of NiFe-AAO nanocomposite which is measured by VSM with different applied magnetic field: in-plane and out-plane.	26
.....	26
Fig. 3-1-2: The EDS analysis of NiFe-AAO nanocomposite	26
.....	26
Fig. 3-2-2: The equivalent Quality factor of NiFe-AAO and Air-core inductor.	29
Fig. 3-2-3: The electromagnetic wave generated by the spiral inductor	30
.....	30
Fig. 3-2-4: The magnitude of electric field pattern simulated by ANSOFT HFSS	31
.....	31
Fig. 3-2-5: The $\pi$ -model of spiral inductors. ....	31
Fig. 3-2-6: The $\pi$ -model of (a) Air-core inductor and (b) NiFe-AAO inductor	33
.....	33
Fig. 3-2-7: The measured high frequency characteristic of MEMS NiFe-AAO inductor (a)The inductance of inductors and(b)The Quality factor of inductors	

.....	35
Fig. 3-2-8: The simulation model is constructed by ANSOFT HFSS.....	38
Fig. 3-2-9: The case of MEMS inductor with 46x46 Ni array is taken to compare the results of removing silicon oxide, removing AAO template and removing both of them respectively.....	39
Fig. 3-2-10: The diagram in (a) shows the $\pi$ -model of the MEMS NiFe-AAO inductor in a short piece, and the Miller coefficient can be calculated by two nodal voltages $V_1$ and $V_2$ as labeled in (b), applying Miller Theorem, $C_{AAO}'$ can be divided in two branches of capacitor as shown in (c).....	42

## Table Captions

### Chapter 2

Table.2-1.The content of NiFe electrolyte.....	19
--	----

### Chapter 3

Table.3-1. Extracted elements of the spiral inductor model with and without NiFe core.....	32
--	----

