行政院國家科學委員會專題研究計畫　期中進度報告

子計畫四：新穎磁性多層膜奈米磁區結構之製作分析與鑄型應用元件製作(1/3)

計畫類別：整合型計畫
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中、英文摘要及關鍵詞(keywords)。

在本三年期整合型計畫第一年研究期間，我們持續探討微磁學相關的部分涵蓋（一）微米級鎳鐵環；（二）磁通動力學；及（三）磁點為催化之碳奈米管生成。就研究成果而言，接續去年七月之前發表的相關論文（下面所列Ref 4,5,6），一年來就所深入探討的部分，目前已有三篇論文發表（本報告所附Ref.1,2,3）。

尤其對鎳鐵環的研究（下面附件1），我們不僅對磁矩分佈有更進一層的認識，尤其洋蔥態及漩渦態及其相混和態的形成時機，更對磁矩動態翻轉有了一定程度的掌控，直徑、線寬、及磁膜厚度相關之上述現象也完全掌握。目前更進一部以電流誘致之方式特意操空磁矩動態行為，相信在第二年會有更豐富的成果。

另外磁通動態的研究乃是磁區丁扎機制上，進一步研究幾何型態的相對應現象（下面附件2），相信有助釐清部分混淆之物理基礎概念。第三部份之磁點催化研究（下面附件3），將有助單一碳奈米管元件形成的可能。相信第二年的研究，將能持續甚至超過第一年之成果。

關鍵詞：微磁學，鎳鐵環，磁通動力學，碳奈米管，磁矩動態翻轉

During the first year of this three-year joint project, the micro-magnetism-related subjects studied in this sub-project are (1) magnetization configuration and it’s evolution under external magnetic field on micro-structured permalloy ring devices; (2) flux dynamics in superconductor having regular artificial pinning centers; and (3) magnetic dots as catalyst for the synthesis of carbon nanotubes, respectively. Regarding to the research achievement, three journal papers (Ref.1, 2, 3 listed below) have been published in continuing the previous related papers before last July (Ref. 4, 5, 6 listed below.)

In the first subject, we have thoroughly studied the formation of vortex, onion, and mixed states in the permalloy ring devices. Furthermore, the dynamic behavior of magnetization subjected to external magnetic field has also been investigated. The size dependent of the domain configurations as well as the transition fields of vortex-to-onion and onion-to-vortex have been worked out in terms of the ring diameter, linewidth, and the thickness. Best of all, we have also studied the ring magnetization reversal by using current-induced magnetic field, i.e. with a current post running through the ring center, which may offer an alternative and as best way of read/write technique in the field of magneto-resistive random access memory.

The flux dynamic in superconductor associated with regular artificial pinning centers was studied in understanding the flux quanta formation through various geometries of the pinning centers arrangement. We believe that this study may lead to the understanding of fundamental Physics. The last part is a study in collaboration with Professor Ma at the Department of Physics, National TongHua University. We have successfully fabricated submicron iron dots array and have this array as catalyst for the synthesis of carbon nanotubes. The final goal will be focused on selective growth of single nanotube device, with which the pure research on this field may lead to real applications.

Keywords: Micro-magnetism, permalloy ring, flux dynamics, carbon nanotubes, magnetization

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