Abstract

Exchange coupled composite (ECC) media is one of the potential candidates in the advanced media design. The basic concept is a reduced switching field with remaining high thermal stability provided by two coupled soft and hard magnetic layers. The film structure which is extended to CoCrPt-SiO_2/Pt assisting layer of multi-layer design has been realized by experiment [1]. These assisting layers provide a higher thermal stability and a reduced switching field.

Many complex mechanisms, like the exchange coupling force between soft layers inside single grain, and the film thickness dependence on the domain wall assisted reversal behavior, are key issues for further advanced design on this novel media. But these concepts are not easy to be verified by experiment.

This article focus on the design of film structure in the point of micromagnetic simulation, especially about inter-layer coupling strength and the number of assisting layers. This work begins at single grain model, and then it is extend to a 7-grain cluster model. In the case of single model, we find the inter-layer coupling J is critical in the magnetic property. When it is increasing, we can observe the lower energy barrier occurs in the reversal process. But if a much larger J is proposed, the switching field finally increases. This means an optimum coupling strength exists. The second issue in single grain model is adjusting the

soft layer number. A clear trend illustrated from the modeling result shows that, the switching field can keep decreasing until the soft layer number reaches 9. This configuration gives the evident that this critical thickness is equal to the intrinsic domain wall width. The simulation works involved here are based on the OOMMF code, developed by M. J. Donahue and D. G. Porter, NIST.

When the lateral coupling force between grains is introduced, the grain cluster model performs a result more approaching the real experiment data. It can ensure the reliability of this work and provide a powerful guideline for further film structure design.

中文摘要

交互偶合復合式記錄媒體是現今最具潛力的新穎記錄媒體之一。基本的概念是偶合兩層磁性質差異很大的軟磁和硬磁層，能在保持熱穩定度的情況下大幅降低翻轉場。多層輔助寫入功能的軟層已經在實驗上被研究。其中有許多複雜的機制，如軟層間交互偶合力、軟層層數對磁壁輔助翻轉機制的影響等議題。這些主題在新式的交互偶合復合式記錄媒體的設計上都相當關鍵，但在實驗上卻不容易被有系統的討論。

這篇文章使用 OOMMF 微辭學模擬軟體對多層膜(軟層輔助寫入層)式交互偶合復合式記錄媒體進行微觀磁性分析，分別建立了單顆、雙顆，和七顆晶粒團簇三種模擬的模型。在單顆的模型內討論軟層間交互偶合力，和軟層層數對磁壁輔助翻轉機制的影響等議題進行探討。發現交互偶合力有一最佳值能最優化翻轉場降低。並且當軟磁性輔助寫入層層數持續增加到晶粒內部磁壁長度時，可以達到最大的反轉場降低效果。七顆晶粒團簇模型提供中央晶粒更接近真實環境，我們亦可以由其中觀察到更接近真實實驗數據的結果。顯示了這套模型的可靠度和對於新式膜層的設計，可以提供一個具參考價值的準則。