

# Magnetic Domain Wall Manipulation using MFM Probe

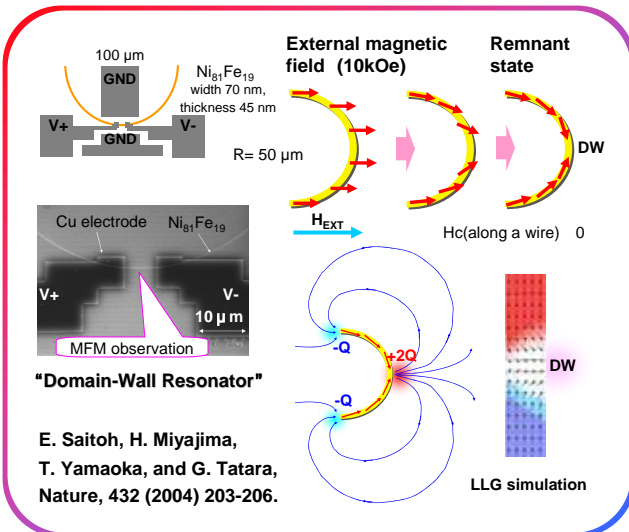
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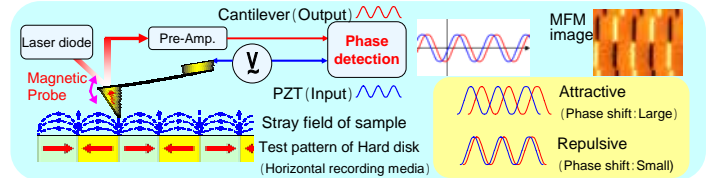
## Abstract

Researches on ultra high-density magnetic recording are actively being pursued. Moreover nano scale magnetic patterns are energetically being studied with the aim of creating new magnetic devices. For the application of the spin electronics in devices, control and observations of magnetic domain structure are very important. High-Resolution Magnetic Force Microscopy (MFM) using a low moment probe and the Q-control method in a vacuum is a powerful tool for exploring nano scale magnetism [1]. We have succeeded in the observation of the nearly-free single domain wall (DW) using High-Resolution MFM. Here, we report the effects of the MFM probe's stray field in observations of the single magnetic DW using the low-/medium-/high-moment probe. [1] T.Yamaoka et al., J. Magn. Soc. Jpn., 27 (2003) 429

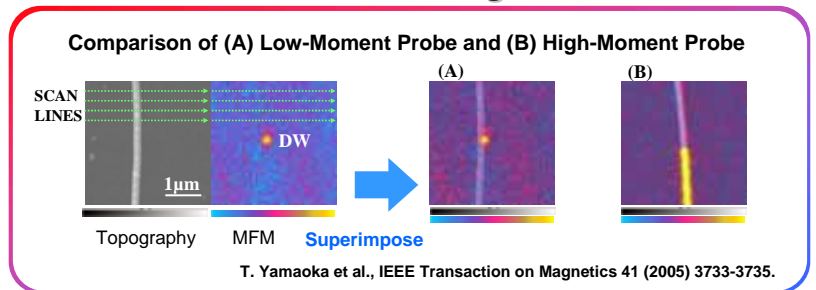
## Single Magnetic Domain Wall



## Principle of Magnetic Force Microscopy



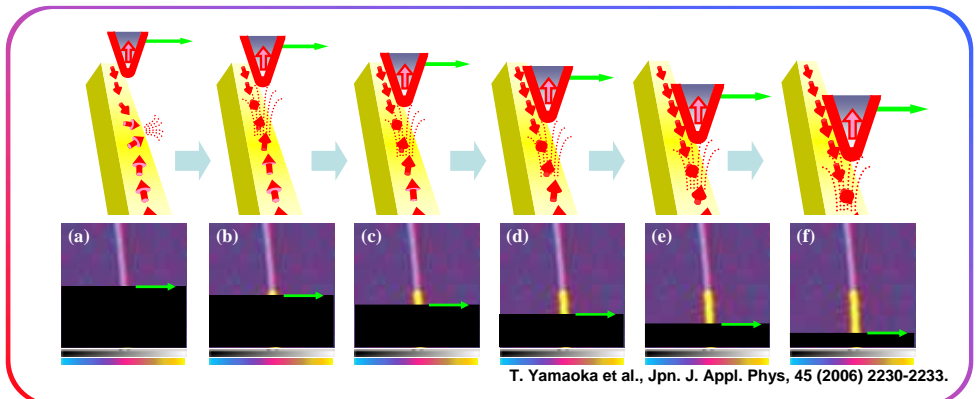
## MFM Observations of Single Domain Wall



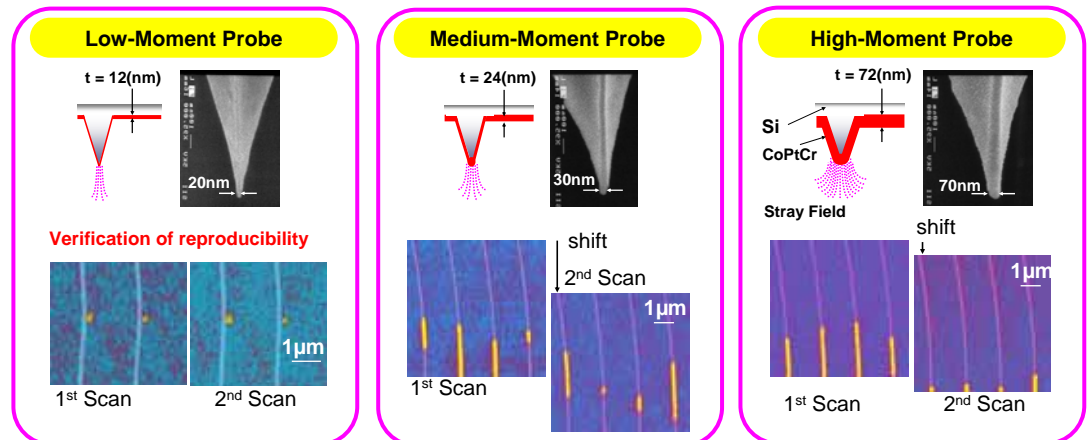
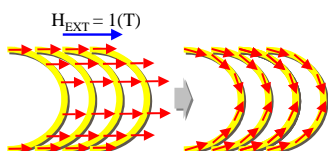
## Magnetic Domain Wall Manipulation using High-Moment MFM Probe



- SPM model:  
 NanoNavi/E-sweep  
 SII NanoTechnology Inc.  
 High-Resolution MFM  
 • Q-Control in a Vacuum  
 • Low Moment Probe



## MFM Observations of Single DWs in Multistep Wires using Several MFM Probes



## Summary

When low-moment probe was used, the observed images were consistent with the micromagnetic simulation and the DWs were reproducibly observed. In the case of high-moment probe, DW manipulation is observed. This phenomenon has suggested that the DWs were dragged by the stray field from the MFM probe. By shifting the second scan purposely lengthwise, the DWs were restricted to the first-scan end point in second scan image. In the case of medium-moment probe, we found that the MFM probe liberated the DWs in the middle of scanning; the first scan and the second scan show similar image. Furthermore, the displacement of the DWs varies, implying competition between the driving force of the DW affected by the stray field from the MFM probe and the friction of the DW in the permalloy semicircular wire loop.