Graded bit patterned media via helium ion irradiation

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Several methods have been employed to fabricate bit patterned media in order to optimize the switching field distribution. Directed self assembly, nano-imprint, and ion irradiation have been demonstrated as viable options for media fabrication, but these methods have not addressed the random location of nucleation sites which dominates the switching field distribution. This article explores a modified ion irradiation method to control the nucleation sites on bit patterned media.

Nucleation sites occur in areas with low magnetic anisotropy[1]. Light ion irradiation has been shown to reduce magnetic anisotropy of Co/Pd and Co/Pt multilayers by intermixing the interfaces. To confine the damage to a fixed local region on the bit, bit patterned media was fabricated with a thick layer of residual resist after pattern transfer via argon milling. The residual resist serves as an ion stopping layer capable of blocking helium ions. An off-axis irradiation of the sample creates localized edge damage producing a binary anisotropy distribution in every bit. This technique enables coercivity tuning and produces a theoretically more stable graded media configuration.

SRIM simulations show that 100 nm of HSQ resist is capable of blocking helium ions of up to 2.5 kV energy. Therefore we fabricated 100 nm bit patterned media with 100 nm of residual resist. The media is then irradiated with ion energies ranging from 6 kV to 1 kV and ion doses of up to 800 uC/cm^2. Fig 1 shows the reduction of coercivity in the media from increased irradiation damage. We also observe that lower energy irradiation cause the same amount of damage/intermixing at lower doses, as predicted by SRIM, Fig. 2.

[1] J.M. Shaw, SE Russek, et al., Phys. Rev. B **78**, 024414 (2008)

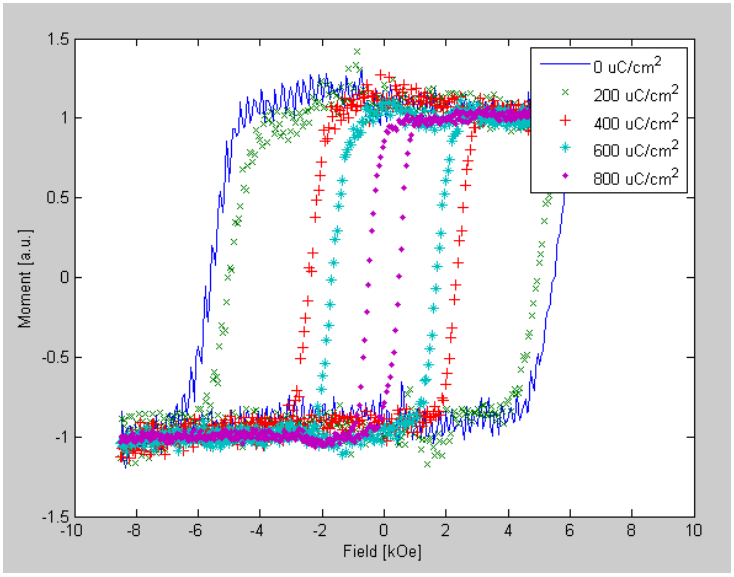

Figure 1: Effect of 6 kV He ion Irradiation on BPM: Helium ion irradiation reduces the coercivity of bit patterned media.

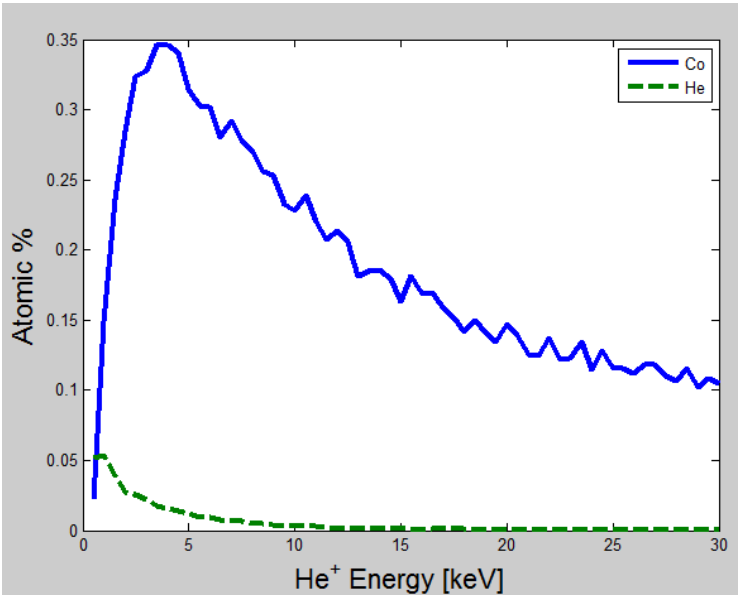

Figure 1: Recoiled atoms in Pd: Helium ion irradiation causes intermixing at the interface. At lower energies, more Co atoms are recoiled into the Pd layer.