Self-assembled Co-BaZrO₃ nanocomposite thin film with ultra-fine vertically aligned Co nanopillars

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Introduction

- Tremendous research interests have been devoted to explore metal-oxide hybrid structures, because of their promising applications in nanotechnology. [1, 2]
- In this work, PLD deposited Co-BaZrO₃ films show high epitaxial quality with ultra-fine vertically aligned Co nanopillars (diameter <5 nm) embedded in BZO matrix. [3]
- The high density of the Co pillars and suitable coercivity value make the vertically aligned Co-BZO nanocomposites as very promising candidates for high-density perpendicular recording media. [3]

Experimental

- Thin film deposition: Co-BZO thin films were deposited by pulsed laser deposition (PLD) on STO substrates at various frequencies.
- Microstructure Characterizations: TEM and XRD.
- Magnetic properties measurement: Physical property measurement system (PPMS).

Results and Discussion

For both out-of-plane (OP) and in-plane (IP) directions, Hc decreases with increasing deposition frequency, from 1020 Oe (2 Hz) to 600 Oe (20 Hz) for OP and from 325 Oe (2 Hz) to 280 Oe (20 Hz) for IP.

The changing of the Hc with different deposition frequencies (Co pillar diameter) is determined to follow the coherent rotation mode.

Conclusions

- Self-assembled ultra-fine Co nanopillars (diameter <5 nm) have been embedded into BZO matrix, for the first time by a simple one-step pulsed laser deposition (PLD) technique.
- The diameter of Co nanopillar can be tuned in the range of ~2.5 nm to ~4.8 nm, or larger, with further deposition parameter optimization.
- A high saturation magnetization of ~1375 emu/cm² in the Co-BaZrO₃ nanocomposites has been achieved, and the coercivity values of this nanocomposite thin films range from 600 Oe (20 Hz) to 1020 Oe (2 Hz), the small diameter of Co pillar allows a high density data storage of 5 Tb inch⁻². All these properties make the nanocomposite platform an ideal candidate for high-density in-plane recording media.

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References