

Effect of Field Deposition on Co/Cu Barcode Nanowires by Electrochemistry

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1. 서론 (Introduction)

Investigation of the effect of an external magnetic field exercised during sample preparation attracts great attention for it can be used potentially to tailor the properties interested, e.g. magnetic anisotropy and reaction kinetics, but also to reveal physics such as spin-orbital interactions under the magnetic field. However, the effect in most cases is weak and insignificant. On the other hand, template fabrication of nanowires is pursued for fundamental study and practical applications. In this work, we fabricate Co/Cu barcode nanowire arrays by pulse electrodeposition into anodic aluminum oxide (AAO) porous nanostructure of different pore size under an external magnetic field (field deposition).

2. 실험방법 (experimental Method)

Co/Cu multilayer nanowires (50nm and 200nm) were fabricated by DC electrodeposition using AAO templates. Before electrodeposition, one side of AAO membrane was coated with a gold layer as a working electrode for reduction of metallic ions from electrolyte. The bath consists of 1M CoSO₄·7H₂O and CuSO₄·5H₂O in deionized water, ratio of each ion was 40:1 and pH value was adjusted to 3.0 by adding dilute H₂SO₄. The electrodeposition was carried out under cathodic pulses of 40 mA/cm² and 0.5 mA/cm² for a variety of durations to fabricate Co/Cu multilayered nanowires generated by Keithly 2400 power station. Applying a magnetic field 400 Oe during deposition was achieved with the field direction perpendicular and parallel to the substrate surface.

3. 실험결과 및 고찰 (experimental Result)

TEM/EDX was used to examine the morphology and composition of the nanowires prepared. The structural information was obtained by x-ray diffractometry (XRD) and the magnetic properties were analyzed by a vibrating sample magnetometer (VSM). It is found that the pore size greatly affects the magnetic properties. The effect of field deposition is unambiguously manifested for the pore size of 50 nm, whereas it diminishes for the case of 200 nm. The microstructural analysis shows single-crystallinity of the nanowire growth in the smaller pore size as a result of geometrical confinement, quantum finite-size effects and synergetically amplified by magnetohydrodynamics in the presence of the external magnetic field during deposition. Moreover, the influence of the segment lengths on the magnetic properties is investigated in terms of shape and magnetocrystalline anisotropy, inter-wire and/or inter-segment dipole-dipole interactions.

4. 결론 (Conclusion)

We have investigated the effect of external magnetic field exercised during fabricating Co/Cu multilayer nanowires in anodic aluminum oxide (AAO) templates using pulse electrodeposition. The effect is most significant when the pore size is small. The influence of the segment lengths on the magnetic properties is addressed in terms of shape and magnetocrystalline anisotropy, inter-wire and/or inter-segment dipole-dipole interactions.

5. 참고문헌 (Reference)

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