

Unexpected Development of Perpendicular Magnetic Anisotropy in Ni/NiO Multilayers After Mild Thermal Annealing

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Abstract

We report on the significant enhancement of perpendicular magnetic anisotropy of Ni/NiO multilayers after mild annealing up to 90 min at 250 degC. Transmission electron microscopy shows that after annealing, a partial crystallization of the initially amorphous NiO layers occurs. This turns out to be the source of the anisotropy enhancement. Magnetic measurements reveal that even multilayers with Ni layers as thick as 7 nm, which in the as-deposited state showed inplane anisotropy with square hysteresis loops, show reduced in-plane remanence after thermal treatment. Hysteresis loops recorded with the field in the normal-to-film-plane direction provide evidence for perpendicular magnetic anisotropy with up and down magnetic domains at remanence. A plot of effective uniaxial magnetic anisotropy constant times individual Ni layer thickness as a function of individual Ni layer thickness shows a large change in the slope of the data attributed to a drastic change of volume anisotropy. Surface anisotropy showed a small decrease because of some layer roughening introduced by annealing.

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Key



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