Layer selective modification of magnetic properties of Co1/Au/Co2/Au multilayers by He ion bombardment

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Possibility to locally change properties of magnetic thin film materials is important in view of their applications in the magnetic storage industry. Of particular interest is a non-topographic, i.e., purely magnetic, patterning which can be realized by an ion bombardment (IB). This technique was successfully applied in systems displaying perpendicular magnetic anisotropy (PMA) to realize a magnetic easy axis (EA) switching in Co/Pt and Co/Au multilayers (MLs). Here we show that the IB with He^+ ions can be used to change the anisotropy direction of the thicker Co layers in a $[Co_1/Au/Co_2/Au]_4$ ML while the perpendicular orientation of magnetization in the thinner Co layers is preserved.

Sample preparation:

-magnetron sputtering

-surface anisotropy of Au/Co interface ensures perpendicular anisotropy of Co layers

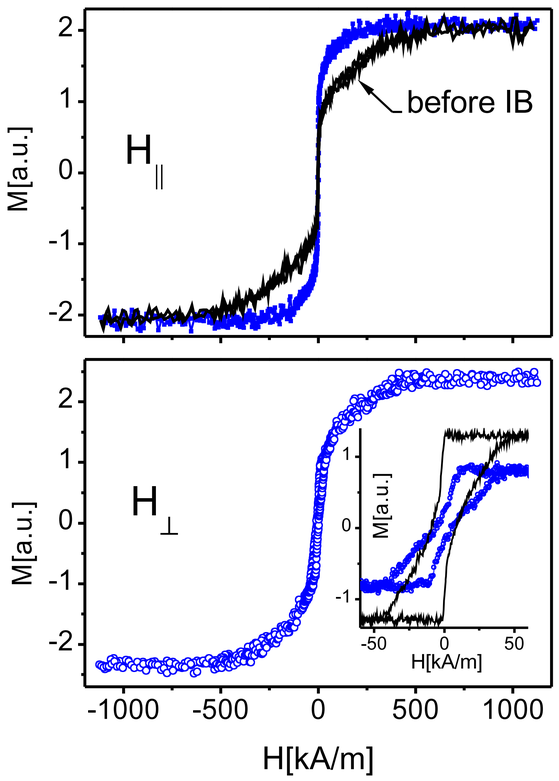
-bombardment with 10keV He^+ ions

$Co_1(0.6nm)/Au(4nm)/Co_2(1nm)/Au(4nm)]_4$

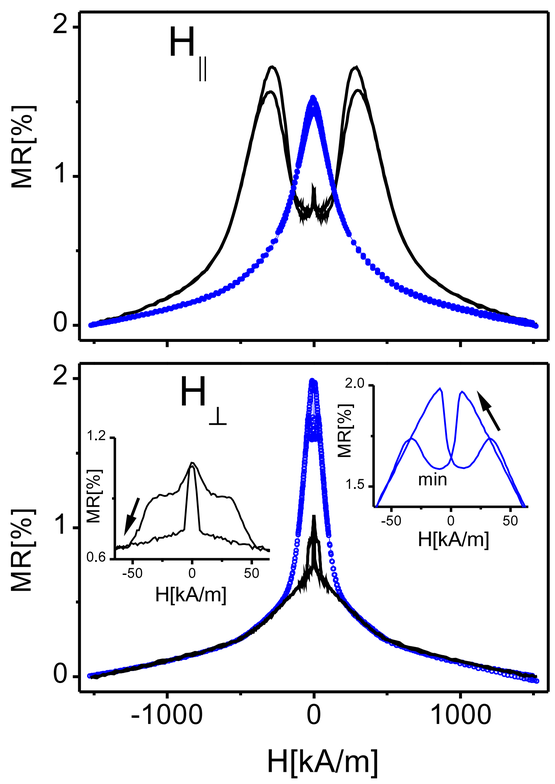
Experimental:

-**Giant Magnetoresistance** utilized to probe the mutual orientation of the magnetic moments of Co_1 and Co_2 layers

-**Vibrating Sample Magnetometry**- magnetic properties



The field dependencies of the magnetic moment of the $[Co_1(0.6nm)/Au(4nm)/Co_2(1nm)/Au(4nm)]_4$ ML before and after the IB with He^+ (10keV, $6x10^{14}$ions cm^{-2}). The upper panel shows the dependencies measured with the field applied in the sample plane and the lower for the perpendicular configuration. The inset shows the small field range hysteresis of the Co layers.



The field dependencies of the resistance corresponding to M(H) dependencies shown left. The upper panel shows the dependencies measured with the field applied in-plane and the lower for the perpendicular configuration. The insets show the expanded view of the small field range resistance changes. The arrows show a field sweep direction.

Modification of properties:

Before the ion bombardment:

-all Co layers possess the perpendicular anisotropy

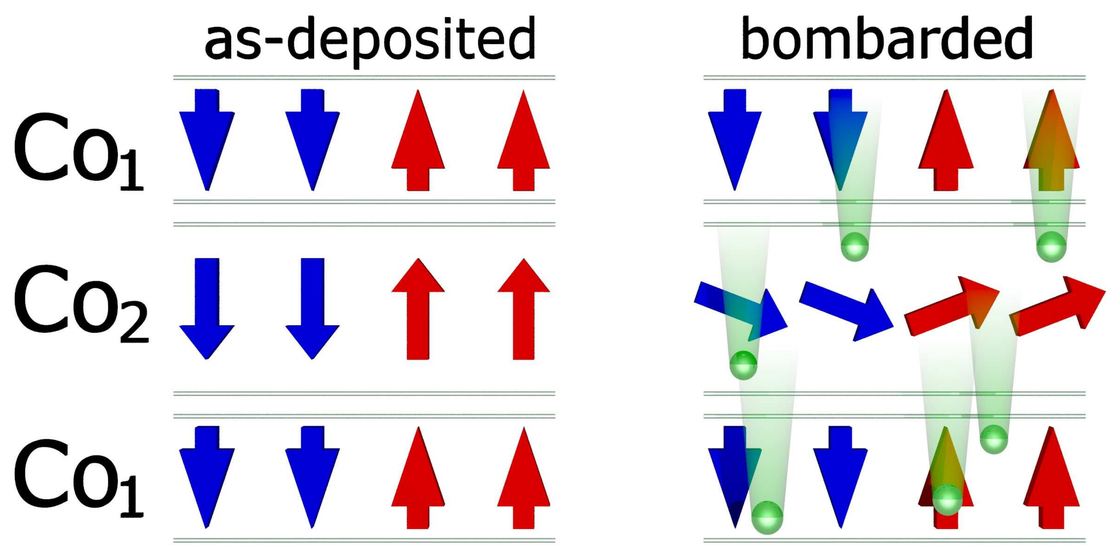
After the ion bombardment:

-thin Co layers (0.6nm) still possess the perpendicular anisotropy

-thicker Co layers (1nm) have in-plane anisotropy

The part of the hysteresis corresponding to the in-plane anisotropy increased by about 60% as a result of the IB while the part corresponding to the PMA decreased 35% (inset the left figure). In absolute values of the magnetic moment these changes are equal, meaning that in the part of the Co layers the EA changed its orientation to in-plane. This behavior was already observed in the Co/Pt systems.

After IB the R(H) dependence characteristic for layers with PMA and the dense domain structure is transformed into the dependence observed for MLs with alternating in-plane and out-of-plane anisotropies in successive layers [1-3].



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