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Keywords: magnetism; mesoporous; neutrons

FA2-MS09-P04

Enhanced Orbital Magnetic Moment of An Highly Ordered Epitaxial FePt Thin Film Grown from Multilayers by Ion Assisted Sputtering Deposition.

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FePt alloy in a *L*10 ordered structure is one of the best materials for the future high density perpendicular recording hard disk due to its high magnetocrystalline anisotropy energy and perpendicular magnetic anisotropy (PMA) property. The ordered FePt thin film was obtained by annealing the as deposited Fe/Pt mulitlayers grown by low energy ion assisted sputtering on the MgO(001) substrate. An epitaxial highly ordered (order parameter 0.95) L10 FePt film was obtained. X-ray magnetic circular dichroism (MCD) on Fe L-edges was used to measure the orbital and spin magnetic moments of the thin film. The out-of-plane MCD signals increases with increasing annealing temperatures. The out-of-plane orbital-to-spin ratio is found to be proportional to the order parameter. The enhancement of orbital to spin magnetic moment is more than 100%. This enhancement may be due to a strong interfacial hybridization between Fe and Pt layers at interfaces and consequently, results in a strong PMA effect.

Keywords: magnetic thin film; X-ray diffraction; epitaxial layers

FA2-MS09-P05

X-ray Scattering Study of the Phase Transition in $Nd_{1/2}Sr_{1/2}MnO_3$.

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The colossal magnetoresistance (CMR) conjugating with the lattice distortions in manganese oxides shows the very reach and fascinating physical phenomena, such as charge, orbital and spin ordering, and has motivated extensive studies. Experiments have revealed a rich phase diagram with a variety of different structures as a function of stoichiometry, temperature, and applied magnetic field [1]. For instance, in the case of $Nd_{1-x}Sr_xMnO_3$ [2], the compound undergoes a transition from a paramagnetic insulator to a ferromagnetic metal for $x < 0.48$, and from a paramagnetic insulator to a *C*-type antiferromagnetic insulator for $x > 0.63$. For a hole concentration of $0.48 < x < 0.52$, $Nd_{1-x}Sr_xMnO_3$ first undergoes a transition to the ferromagnetic metallic state at about 250 K, and then becomes an *A*-type antiferromagnetic metal at about 200 K. Upon further cooling, it becomes a *CE*-type antiferromagnet at about 160 K, at which it has been reported to coexist with the *A*-type antiferromagnetic state at low temperatures. The *CE*-type antiferromagnetic state displays both charge and orbital ordering. The *CE*-type charge and orbital ordering are characterised by the alternate ordering of the Mn^{3+} and Mn^{4+} ions and by the ordering of $d(3x^2\text{-}r^2)$ and $d(3y^2\text{-}r^2)$ orbitals on the Mn^{3+} sites. The unusual magnetic and electronic properties in these materials result from interaction between charge, spin, orbital and lattice degrees of freedom, which are strongly coupled to each other.

We take $Nd_{1/2}Sr_{1/2}MnO_3$ [2] as an example to demonstrate the observation of a sequent phase transition using high resolution x-ray scattering [3]. By measuring the peak profile of Bragg reflections, upon cooling, we observed an increase in the width of the Bragg reflections around the Curie temperature (252 K) corresponding to the transition from a paramagnetic to a ferromagnetic state. Below approximately 200 K, dramatic changes in the width and integrated intensity were observed. Changes continued until the formation of charge ordering with $q = (1/2, 0, 0)$ at T_{CO}=152 K. This charge ordering was observed to be the first order transition and display a large hysteresis width of 10 K. This sequent transition can be understood to be caused by the formation of different magnetic domains as that observed by neutron powder diffraction [3].

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Keywords: X-ray scattering; phase transition; charge ordering