Determination of rotatable and frozen antiferromagnetic spins in exchange biased CoO/Fe/Ag(001) system J. WU, J. PARK, UC-Berkeley, WONDONG KIM, KRISS, E. ARENHOLZ, M. LIBERATI, Lawrence Berkeley Nat. Lab., CHANYONG HWANG, KRISS, Z.Q. QIU, UC-Berkeley — X-ray Magnetic Circular and Linear Dichrisms are applied to epitaxially grown CoO/Fe/Ag(001) system to obtain both the ferromagnetic Fe and antiferromagnetic CoO hysteresis loops. The observation of the antiferromagnetic CoO hysteresis loop in the exchange-biased CoO/Fe bilayer illuminates the existence of two types of CoO spins (rotatable and frozen) in response to the Fe magnetization reversal by an external magnetic field. The absolute amounts of the rotatable and frozen spins are determined as a function of the CoO thickness to give a direct comparison to the exchange bias field of the Fe film. We find a surprising result that the exchange bias is well established before the CoO spins are frozen. This result suggests that the current theoretical models need to exam the common assumption that frozen antifferomagnetic spins are a necessary condition for the exchange bias. By using 2ML NiO as a probe layer inside the CoO film, we also show that the rotatable/frozen spin ratio is uniform for each layer of the CoO film, ruling out the formation of CoO domain wall in the mormal direction of the film.

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