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Shaping nanoscale magnetic domain memory in ferromagnets by field cooling

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Magnetic nanostructures, such as magnetic domains in perpendicular thin ferromagnetic layers, draw an increasing attention for their potential applications in nanotechnologies. Magnetic domain memory (MDM), i.e. the ability for the domain pattern to retrieve its exact same spatial configuration through field cycling, can be particularly useful in magnetic recording technologies. I will show how X-ray synchrotron tools can uniquely help understand the behavior of these magnetic systems at the nanoscale. More particularly, I will review the technique of Coherent X-ray Magnetic Scattering (CXRMS) and how it can be used to measure MDM in thin ferromagnetic films. Because illuminating a magnetic pattern with coherent X-rays produces a speckle scattering pattern that is a unique fingerprint of the magnetic domain configuration (Fig.1), cross-correlating such speckle patterns provides a way to measure MDM. I will present results on [Co/Pd]IrMn exchange bias thin films that exhibit strong MDM (above 95%) when cooled down below their blocking temperature [1]. By mapping the correlation as function of magnetic field, I will show how the behavior of MDM depends on magnetic history and cooling field. We will see that, when zero-field cooled, the MDM reaches its maximum value in the coercive region of the magnetization cycle [2]. We will also see that MDM is fairly robust through field cycling and through heating, all the way up to the blocking temperature [3]. 1. K. Chesnel et al, *Phys. Rev. B* **78,** 132409 (2008) 2. K. Chesnel et al, *Phys. Rev. B* **83,** 054436 (2011) 3. K. Chesnel et al, *New Journal of Physics* **15,** 023016 (2013)