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Magnetic coupling through lanthanum nickelate in non-metallic (111) $LaMnO_3/LaNiO_3$ superlattices

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Perovskite nickelates ($RNiO_3$, RE = Rare Earth) are fascinating materials, well known for their metal to insulator transition (MIT) and unique antiferromagnetic (AFM) ground state [1]. In this presentation, I will first discuss how one can control the MIT and the magnetic properties of high quality epitaxial nickelate films through a variety of techniques [2-6]. I will then describe our work on heterostructures containing $LaNiO_3$ – the only member of the family that is metallic and paramagnetic in the bulk down to low temperature – and ferromagnetic $LaMnO_3$. In this system we observed an unusual exchange bias in [111] oriented $(LaNiO_3)/(LaMnO_3)$ superlattices [7] and an antiferromagnetic interlayer exchange coupling above the blocking temperature of the exchange biased state specifically in 7 unit cells $LaNiO_3$/ 7 unit cells $LaMnO_3$ superlattices. The antiferromagnetic coupling is attributed to the presence of a (1/4, 1/4, 1/4) wavelength AFM structure in $LaNiO_3$. The complex exchange bias observed in this $(LaNiO_3)/(LaMnO_3)$ system is explained in this context also considering the presence of two types of interfaces [8]. [1] ML. Medarde, Journal of Physics: Condensed Matter, 9, 1679 (1997). [2] R. Scherwitzl et al., Advanced Materials 22, 5517 (2010). [3] S. Catalano et al., Appl. Phys. Lett. Mat. 2, 116110 (2014). [4] S. Catalano et al., Appl. Phys. Lett. Mat. 3, 062506 (2015). [5] A. Caviglia et al., Phys. Rev. Lett. 108, 136801 (2012). [6] M. Först et al., Nat. Mat. 14, 883 (2015). [7] M. Gibert et al., Nat. Mat. 11, 195 (2012). [8] M. Gibert et al., Nanoletters in press (2015).