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

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Perovskite nickelates ($RNiO_3$, R=rare earth), with the exception of $LaNiO_3$, display a bandwidth-controlled metal insulator transition (MIT) and antiferromagnetic order in the low temperature phase. Tuning of the MI and Néel transitions is efficiently achieved in nickelate thin films over a wide temperature range, and even $LaNiO_3$ films undergo a MIT as the thickness is decreased. In this reduced dimensionality regime of $LaNiO_3$, we will also report how interface engineering can be used not only to induce a new magnetic phase in this otherwise non-magnetic material but also to generate rich and complex magnetic behavior in (111)-oriented $LaNiO_3/LaMnO_3$ heterostructures. For 7-monolayer-thick $LaNiO_3/LaMnO_3$ superlattices, the emergence of negative and positive exchange bias is observed at low temperature before the stabilization of an antiferromagnetically coupled state between the $LaMnO_3$ layers above the blocking temperature. This behavior is explained by the onset of an antiferromagnetic spiral of (1/4, 1/4 ,1/4) wave vector in the ultrathin $LaNiO_3$ layer, akin to that of the other bulk insulating nickelates. Influence of the degree of intermixing at the monolayer scale on the interface-driven properties will also be discussed.