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Artificial chemical and magnetic structure at the domain walls of an epitaxial oxide.

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Progress in nanotechnology requires new paradigms for materials synthesis that allow controlling their functionality down to the smallest scales. Here we report a novel two-dimensional ferromagnetic phase that is synthesized at the domain walls (DWs) of the antiferromagnetic insulator $TbMnO_3$ when grown in thin layers under epitaxial strain. This Mn oxide phase presents an atomic arrangement that does not exist in bulk and cannot be synthesized by standard chemical routes. The number of 2D ferromagnetic sheets can be controlled by tuning the thickness of the thin films, giving rise to volume fractions that go up to 25% of the total film volume. Such novel phases are driven by a unique environment induced by the symmetry breaking and large stresses present at domain walls, which function as nanoreactors. This new class of nanoscale materials may find innovative applications in nanoelectronics and spintronics. The work is published as S. Farokhipoor, C. Magén, S. Venkatesan, J. Íñiguez, C. J. M. Daumont, D. Rubi, E. Snoeck, M. Mostovoy, C. de Graaf, A. Müller, M. Döblinger, C. Scheu, B. Noheda, Nature 515, 379 (2014)