Emergence of magnetic phases by geometrically confined doping

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A certain number of theoretical predictions show that in complex oxides the confinement of t_2g electrons to two dimensions can alter strongly the physical properties of these systems compared to their three dimensional counterparts, among them the magnetic ordering. The enhancement of the electronic correlations due to the confinement of the charge carriers may give access to magnetic phases in otherwise non-magnetic materials. To approach experimentally the two dimensional limit, we propose geometrically confined doped superlattices of rare-earth vanadates ($REVO_3$). Here, a one unit cell thick layer of $SrVO_3$ as a doping layer is introduced between insulating $REVO_3$ layers to create conducting zones with a two dimensional character.

We synthesized this kind of superlattices by Pulsed Laser Deposition on $SrTiO_3$ (001) substrates, achieving epitaxial superlattices with a high crystalline quality. The confinement of the doped charge carriers in the vicinity of the doping layers influences strongly the physical properties of the superlattices, giving rise to a room-temperature ferromagnetic phase, while the corresponding bulk solid solutions are insulating antiferromagnets. With the help of theoretically calculated band structures, we will discuss the role of orbital occupation and changes in atomic positions for the creation of these peculiar properties.