Hybrid magnetic heterostructures allow the engineering of new material properties by creative uses of proximity effects. When two dissimilar materials are in close physical proximity the properties of each one may be radically modified or occasionally a completely new material emerges. By properly designing hybrid ferromagnet/oxides new magnetic properties arise unlike any known magnetic materials.

In a series of recent studies, we have investigated the static and dynamic magnetic properties of different hybrids of ferromagnets (Ni, Co and Fe) and oxides (VO₂ and V₂O₅). The vanadium oxides (VO₂ and V₂O₅) are canonical examples of materials showing a first order metal to insulator transition and structural phase transformation. Static properties such as the coercivity, anisotropy and magnetization and dynamical properties such as the microwave response are clearly modified by the proximity effect. Our results indicate that the structural transformation and the nanoscale phase coexistence across the first-order phase transition of the oxides are responsible for the observations in these hybrid materials. The results suggest the existence of similar effects in other hybrid materials and give rise to interesting, perhaps useful, properties.

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