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Stuttgarter Physikalisches Kolloquium

Max-Planck-Institut für Festkörperforschung
Fachbereich Physik, Universität Stuttgart

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Hybrid

Login data will be announced by e-mail and on the colloquium webpage.

Dienstag, 9. Juli 2024 | **16.15 Uhr** | **Lecture Hall 2D5**

Max-Planck-Institut für Festkörperforschung, Heisenbergstraße 1, 70569 Stuttgart-Büsnau

Double-perovskite oxide heterostructures

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Abstract

Atomically-engineered heterostructures constitute excellent model systems for investigating fundamental structure-property relations in transition metal oxides and their evolution as the thickness of the constituent layers is reduced to only a few unit cells. The double-perovskite RE_2NiMnO_6 (RE= rare earth) family is characterized as being insulating ferromagnets, an unusual combination of properties. Ferromagnetism arises through oxygen-mediated superexchange in the rock salt-ordered Ni/Mn sublattice. The Curie Temperature of La_2NiMnO_6 is T_c=280K, and for the other members of the family, T_c decreases linearly with the size of the ionic radius of the *RE*.
Here, we will show that epitaxial RE_2NiMnO_6 films (RE=La, Nd, Sm), grown by RHEED-enabled off-axis magnetron sputtering, display long-range Ni^{2+} and Mn^{4+} order and strain-independent bulk-like T_c at a thickness of 30 unit cells [1,2]. We find that the ferromagnetic behavior occurs down to ultra-low thicknesses of (at least) 3 unit cells (~1.2 nm). However, below 10 unit cells, the magnetic properties deteriorate due to an interfacial charge transfer caused by the polar discontinuity at the $RE_2NiMnO_6/SrTiO_3$ interface [2,3]. For the case of Nd_2NiMnO_6, a detailed x-ray magnetic circular dichroism (XMCD) study allows us to separate the magnetic components into a robust ferromagnetic Ni/Mn sublattice and a paramagnetic Nd sublattice. We will also present our latest efforts in combining different RE_2NiMnO_6 double perovskites into potential multiferroic artificially-layered superlattices [4].

[1] G. De Luca et al., *APL Materials* 9, 081111 (2021).
[2] J. Spring et al., *Physical Review Materials* 7, 104407 (2023).
[3] G. De Luca et al., *Advanced Materials 34*, 2203071 (2022).
[4] H. J. Zhao et al., *Nature Communications* 5, 4021 (2014).