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BiFeO3 Thin Films: From Strain-induced Monodomain Multiferroicity to Probing Magnetoelectric and Photovoltaic Effects

BiFeO3 is one of the very few room-temperature magnetoelectric multiferroics, with its long-range antiferromagnetic spin cycloid coupled to its ferroelectric polarization. However, since three different cycloid propagation directions (ki) are associated with each ferroelectric polarization direction (Pj), the resulting multiferroic landscape may appear as complex in thin films due to the multiple ferroelectric variants. Hence, simplification of the multiferroic landscape of BiFeO3 is crucial for both fundamental understanding and technological advancement.1-3
In the first part of the seminar, I will demonstrate the powerful knob of epitaxial strain to stabilize a single ferroelectric and antiferromagnetic domain structure in BiFeO3 thin films.4,5 Further, by taking advantage of these monodomain films, the magnetoelectric interaction (ME) is studied. Then, I will discuss the origin of the experimentally observed ferroelectric photovoltaic response (FePV) which is often challenging due to the entanglement between bulk and interface effects, leading to much debate in the field. For this, various experimental designs were employed to resolve this dispute exploiting vertical heterostructures based on single-domain BiFeO3.6,7

References:

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(4) Haykal, A., Fischer, J., et al., Antiferromagnetic textures in BiFeO3 controlled by strain and electric field. Nature communications, 11(1), 1704 (2020).
(5) Dufour, P.*, Abdelsamie, A.*, et al., Onset of Multiferroicity in Prototypical Single-Spin Cycloid BiFeO3 Thin Films, Nano Letters 23 (19), 9073-9079 (2023).
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