Unveiling AC electronic properties at charged ferroelectric domain walls

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Ferroelectric domain walls exhibit a range of interesting electrical properties and are now widely recognized as functional two-dimensional systems for the development of next-generation nanoelectronics. A major achievement in the field was the development of a fundamental framework, that explains the emergence of enhanced electronic direct-current (DC) conduction at the walls, including applications as, e.g., switches or in memory applications. In contrast to the functional DC behavior, the alternating current (AC) response of domain walls still falls into a largely unchartered territory.

In this talk, I discuss the much less explored behavior of ferroelectric domain walls under applied AC voltages. I provide an overview of the recent advanced in the nanoscale characterization that allow for resolving the dynamic response of the individual domain walls to AC fields spatially (**Figure 1**). [1] In additional, I will present different examples, showing the unusual AC electronic properties arising at domain walls in the kilo- to gigahertz regime. A particular focus will be on the application of charged domain walls in single-crystalline $ErMnO_3$ in the adiabatic frequency regime (kHz-MHz), demonstrating how the non-linear response at the electrode-domain wall junction can be utilized in applications as rectifiers. [2] I will conclude with a brief discussion on future application opportunities of charged domain walls, expanding domain-wall based nanoelectronics into the realm of AC technologies.

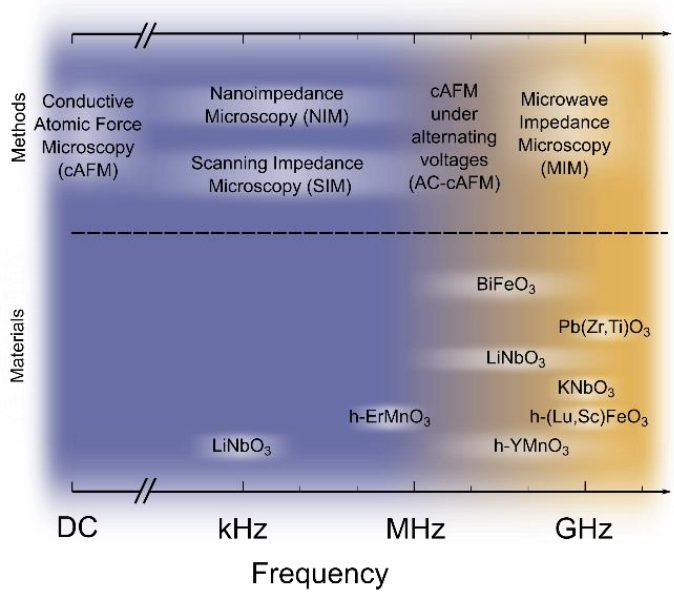

Figure 1: Summary of experimental methods and investigated ferroelectric domain walls in different frequency regimes.

References:

[1] J. Schultheiß *et al.*, http://arxiv.org/abs/2109.07784

[2] J. Schultheiß *et al.*, Nano Lett. (2021), https://doi.org/10.1021/acs.nanolett.1c03182