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Session X04: Dielectric & Ferroic Oxides -- Structure & Functionality of Ferroic Domain Walls
8:00 AM–10:48 AM, Friday, March 8, 2019
BCEC Room: 107C

Sponsoring Units: DMP DCOMP
Chair: Javier Junquera, University of Cantabria

Abstract: X04.00004 : Towards adaptable nano-circuitry - functional domain walls and disorder engineering in improper ferroelectrics

8:36 AM–9:12 AM

Abstract

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Oxide materials exhibit a broad range of tunable phenomena, including magnetism, multiferroicity, and superconductivity. Oxide interfaces are particularly intriguing. The low local symmetry combined with the sensitivity to electrostatics and strain leads to unusual physical properties. Recently, ferroelectric domain walls have attracted attention as conducting and spatially mobile interfaces. In order to ultimately design domain-wall-based devices and circuitry, however, additional functionality beyond just conduction is required.
In my talk, I will discuss how improper ferroelectric domain walls can be used to emulate key electronic components. In the first part, I will address domain walls in $ErMnO_3$. The system naturally develops all fundamental types of ferroelectric domain walls, including neutral as well as negatively and positively charged wall configurations. I will show how the electronic domain-wall properties can be controlled and discuss the possibility to use such walls for designing, e.g., 2D digital switches and half-wave rectifiers [1]. In the second part, I will consider domain walls in spin-spiral multiferroics with strong magnetoelectric couplings and additional functionality that arises from the interplay of charge and spin degrees of freedom. Because of the coupling, it is possible to reversibly control the configuration at ferroelectric domain walls by magnetic fields, switching between nominally charged and neutral domain wall states [2,3]. Furthermore, I will present an innovative approach for controlling conductivity and wiring up domain-wall-based devices with nanoscale spatial resolution, bringing us an important step closer to adaptable all-domain-wall circuitry for next-generation nanotechnology.

[1] J. Schaab, et al., *Nature Nano*. DOI:10.1038/s41565-018-0253-5 (2018)
[2] N. Leo, et al., *Nature Commun*. 6, 6661 (2015)
[3] M. Matsubara, et al., *Science* 348, 1112 (2015)