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Solid State Challenges in Ferroelectrics

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Most ferroelectrics are oxides of a number of different crystal classes. Their polar ordering typically arises as soft phonon process with one or more of the ionic entities shifting within the unit cells. This lowers the symmetry into polar symmetry groups. If nuclear probes substitute the inherent ions in the structure, their local environment more or less reflects the crystal symmetry. One of the biggest challenges in oxides is the control of the oxygen stoichiometry. It will thus often occur that ionic probes are captured near vacancies or vacancy clusters, particularly if the long lived mother isotope is of different charge than the site in the unit cell which it substitutes. If we work on powders, most of the implanted ions will only enter the surface of the powder grains. In well polished ceramics, this can be circumvented to some degree, but grain boundaries offer another disordered environment. Thus, all interpretation of data must be done very carefully. Recently, conducting domain walls, photovoltaic effects and even potentially superconductivity in domain walls have been reported. It is a challenge in the near future to be able to place nuclear probes into the relevant sites in the structure. This could enable access to effects, so far not reported about. This presentation will be speculative in certain parts.

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