PHYSICS COLLOQUIUM

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Ferroelectrics and Ferroelastics far from Equilibrium: Avalanche Spectroscopy

Noise generated by mobile ferroelectric domain boundaries is reported for $BaTiO_3$, PST and related materials. Mobile domain boundaries follow the path of crackling noise in a far-from-equilibrium scenario. This noise is measured by acoustic emission signals and, simultaneously, jerks in the depolarization current and in speckle spectra. Noise exponents for the emitted energy E, their maximum amplitudes A, their duration D and the interevent times T will be discussed. Acoustic emission spectroscopy shows that electric-field switching of 90° boundaries generates large strain fields, which emit acoustic phonons during ferroelectric hysteresis measurements. We use highly sensitive receivers (microphones) to measure the time sequences of noise in close analogy to noise patterns in ferroelastic and magnetic materials (~ Barkhausen noise). The traditional view is to ask how domain walls move under external forcing. The alternative question is to ask what the probability distribution of the totality of all such moves is. Only the latter approach leads to a global response where the switching properties are determined in a statistical manner. 'Jerk' spectra due to acoustic emission (AE), which occurs during ferroelectric avalanches, have seldom been investigated before and current models of avalanche theory have not been applied. With improved technical means this has become possible and full data sets of ferroelectric and ferroelastic noise pattern will be presented.

Ekhard Salje *is professor at Cambridge University since 1985. After work on structural phase transitions, he explored the properties of ferroelastics, martensites, ferroelectrics and functional alloys. He instigated the field of 'Domain Boundary Engineering' where functionalities emerge from domain boundaries while the bulk is simply a spacer for the active device parts. He discovered superconducting domain walls in WO3 and the polarity of twin walls in CaTiO3 and many related materials. Currently he works on the statistical properties of domain walls. He has published over 700 scientific papers*

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