Nonlinear dielectric and piezoelectric properties in oxide materials

Contact:
Prof. Dragan Damjanovic (MXD-236), Tel.: 021 / 693 29 89,
E-Mail: dragan.damjanovic@epfl.ch

The oxide materials exhibit largest piezoelectric response of practical interest and are widely used as high frequency transducers, actuators and sensors. Examples include transducers for ultrasonic medical imaging, high precision scanning actuators, fuel injection actuators and haptic sensors. The large piezoelectric response is closely related to a large dielectric permittivity. The response is often accompanied with hysteresis, relaxation, creep and nonlinearity that are undesired in high precision and high power applications. The origins of these phenomena are not well understood and depend on crystal structure, chemical composition, atomic defects, microstructure and other material properties.

In this project the student will examine selected oxide materials, such as relaxors and ferroelectrics, and investigate origin of the nonlinearity (the field dependence of the piezoelectric coefficients and permittivity). The student will measure dielectric and piezoelectric properties of materials as a function of the electric field amplitude at different frequencies. The student will become familiar with characterization and properties of piezoelectric and ferroelectric materials, concepts of nonlinearity and Fourier analysis and use of different electrical equipment, including oscilloscopes, lock-in amplifiers, function generators, power amplifiers, impedance analyzers, fotonic and LVDT sensors for measurements of nanometer displacements etc.