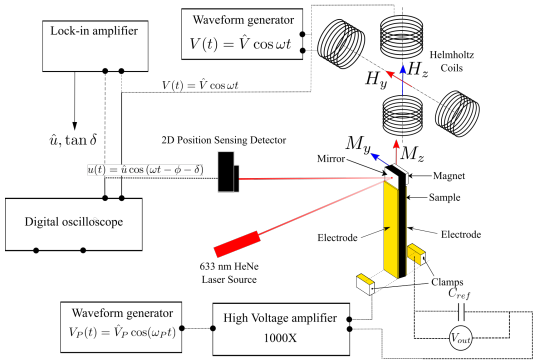
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

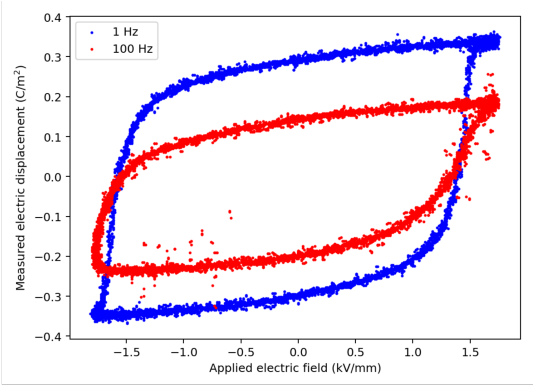
Mechanics & Materials Laboratory
Prof. Dr. Dennis M. Kochmann
www.mm.ethz.ch

Master's thesis/ semester project:

In-situ measurements of polarization switching in ferroelectric ceramics



BES schematic: A schematic of the BES setup housed in the MM laboratory (CLA J34)



Example dataset: P-E curves during dynamic electrical cycling experiments on PZT

Overview: Ferroelectrics are a class of piezoelectric materials with applications ranging from transducer technology to data storage. At the fundamental material length scale, these materials exhibit permanent electrical polarization and a non-linear evolution of polarization and mechanical strain upon the application of external electric field. This electro-mechanical response is strongly dependent on a number of variables including the rate of application of electric field and the composition of the material. A detailed understanding of this phenomenon would significantly improve our ability to tailor materials design for the aforementioned technological applications.

Project description: An experimental setup named Broadband Electromechanical Spectroscopy (BES) is housed within the Mechanics & Materials laboratory (CLA J34) to make in-situ measurements of polarization and mechanical strains during applications of large cyclic electric fields in bulk samples (see Figure). The initial phase of this project will involve understanding the basic theory and design of the experiment, data collection and analysis. The next phase will involve a detailed study of cyclic and step loading experiments on different types of ferroelectric material systems at different electrical loading rates. The final phase will involve a compilation and interpretation of the data in combination with ongoing theoretical and computational studies within the group, to understand the measured kinetics of polarization evolution as a function of loading rate and composition. Potential future directions involve extending the BES measurements to high temperatures.

Pre-requisites: Interested students should have a background in mechanics, materials science, physics or a related field. Experience with experimental mechanics, coding and data analysis using Python/Matlab will be valuable but not mandatory.

For more information please contact:
Dr. Vignesh Kannan (Mechanics & Materials Lab)
Department of Mechanical and Process Engineering
Tannenstrasse 3, CLA J31
email: kannanvi@ethz.ch