Master internship

Title	**High-throughput piezoresponse force microscopy of perovskite piezoelectrics**
Location	Laboratoire PMC – Ecole Polytechnique – Route de Saclay – 91128 Palaiseau
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Group website	https://pmc.polytechnique.fr/spip.php?article623&lang=en
Starting date	Spring 2027

The most widely used piezoelectric material today is lead zirconate titanate (PZT), due to its excellent all-around performance and processability. However, replacing PZT with lead-free alternatives is of political and economic interest due to the well-known dangers of lead to human health and the environment. In the search for new lead-free piezoelectric materials, the perovskite crystal structure offers an unmatched chemical and functional flexibility. Some of the most promising high-d_{33} lead-free material systems that crystallize in the perovskite structure are extremely chemically disordered, and it is unlikely that the best-performing composition has been found. We are developing high-throughput synthesis and characterization methods in order to sample from this large compositional space and perform Bayesian Optimization to propose new compositions with the aim of finding the highest possible d_{33} in the chemical space we are exploring.

In this work, we plan to use atomic force microscopy with the piezoresponse force microscopy (PFM) option to measure the d_{33} of the samples we synthesize in the lab. The PFM technique is sensitive to artefacts, and we need to develop a robust method for data collection and analysis to be able to use the results from this tool in a quantitative manner. Mid-term structural information from x-ray diffraction together with the results from PFM will be used in Bayesian optimization loop to propose new compositions.

Candidates with background and/or interest in condensed matter physics, instrumentation, and data treatment are welcome to apply.

Techniques to be used: atomic force microscopy, piezoresponse force microscopy, python-based analysis

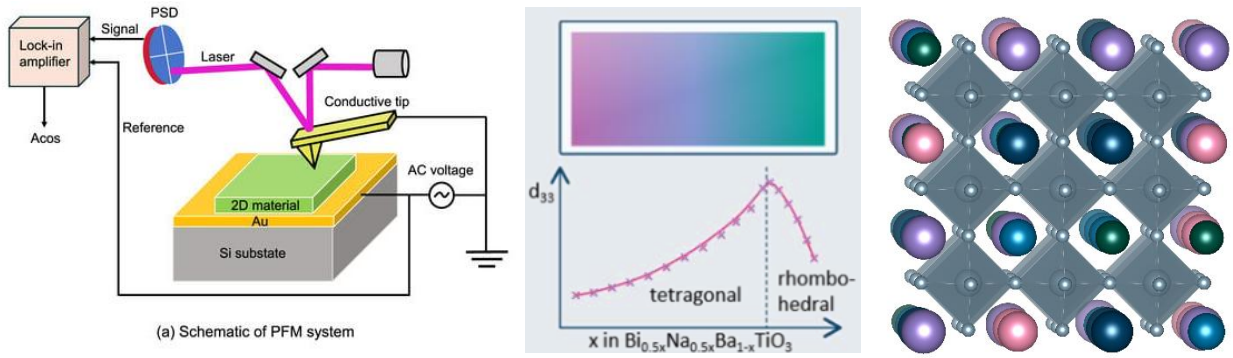


Figure 1 (left) schematic of PFM system, picture credit DOI:10.1088/1361-6463/ac436 (center) sample with chemical gradient and structural phase change associated with high d33 (right) disordered perovskite structure