While lateral strain is a relatively common tool for probing atomic-level magnetic and electric phenomena, shear strain remains uncommon in condensed matter publications. Stacking order and magnetic phases coupled with spontaneous structural distortions are both properties that could be manipulated by a reliable source of shear stress, allowing us new degrees of freedom in the study of broken symmetries in complex solid-state systems. Once the effect of shear strain is better understood, altering the relative position of layers in a crystal has the potential to be a powerful tool for controlling properties with industrial and computing applications. This understanding, altering the relative position of layers in a crystal has the potential to be a powerful tool for controlling properties with industrial and computing applications.

To better characterize the strain applied to the material, a small-scale, precise strain gauge is needed. We designed two kinds of strain gauge to measure the shear displacement using piezoresistive effect and capacitance change, respectively. For both, we have performed several COMSOL simulations to judge their accuracy and robustness under the conditions they will be subjected to.

The first bulk crystal we plan to measure in the pilot test of this strain cell is FeTe. This material undergoes a strong monoclinic structural distortion as it enters its antiferromagnetic phase [5], indicating that it will have a significant response to shear strain.

- FeTe is a tetragonal material in the same family as more famous superconductors such as FeSe and FeTe$_{1-x}$Se$_x$.
- Bulk crystals were grown via the self-flux method and formed, as FeTe almost always does, with extra iron around some small percentage of iron sites in the lattice.
- In its ground state it enters a double-stripe antiferromagnetic (AFM) phase at a temperature of 65 K [1].
- Becomes a bulk ferromagnet under a pressure of 2 GPa [1].
- Theoretical predictions [1] and experiments [3] on thin film FeTe indicate that it can enter a single stripe AFM ordering under tensile strain, an ordering which may be connected to an emergent superconducting phase.

Early measurements to prepare for strain cell tests include performing energy-dispersive X-ray spectroscopy (EDX) to measure excess iron and recording the resistivity along both a and b axes down to 2 K. Results can be seen in the figure below, alongside a picture of the sample measured. Current is applied and voltage measured through gold wires attached with silver paste to gold pads sputtered onto the corners of the crystal.

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