Substrates are the materials on which other processes are conducted, such as pulsed laser deposition growths. Because they are crucial in contributing to the quality of the material grown on it, their structure must be compatible with the target. SrTiO$_3$ (STO) is the substrate we used for research. However, the quality of substrates degrade over time, and we are looking for ways to restore its original quality.

### Etching:

Etching is a process to remove certain layers from a structured specimen in order to obtain only the layer we want. Since STO is structured with distinct layers (each with their own atoms and configuration), etching works well in isolating the layer we want (TiO$_2$ surface termination). In order to do so (with the case of STO), we use a buffered HF solution to remove the impurities.

### Annealing:

Annealing is a process in which a material is heated to a high temperature in the presence of a gas (in our case, pure O$_2$) in order to help the atoms on the surface settle. This can help make a rough surface smoother.

### Atomic Force Microscopy:

AFM is a process to visualize the surface of a material. A tip is attached to a cantilever and the machine uses this to tap the material’s surface. A laser is pointed at the backside of the tip and fires a beam which is then reflected and collected by a photodiode. The cantilever bends, and this causes the reflected angle to change, which allows for imaging of surface.

### Next Steps

The next step would be to experimentally find a way to obtain consistent better quality step-terraces for the STO substrates. We can also find the cause of degradation of the surface over time.

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