

Measuring etch rates with the drop gauge

The drop gauge is a simple to use, tabletop vertical displacement measuring device in SNF. It has micron level resolution and can be used to characterize micron to millimeter scale etch rates. For example, we used it to measure the etch rate of a PT-DSE recipe for blanket etching hundreds of microns of Si.

The drop gauge consists of a needle that can be raised and lowered, a digital display that can be zeroed, a stage, and a plastic block. The sample sits on the plastic block, which is glued into place on the stage directly under the needle, shown in Figure 1a. To zero the gauge, press and hold the zero button. Take readings from different areas on the etched sample. For example, we took measurements near the corners and in the center of the etched area on our sample. These can be averaged when calculating the etch rate.

Although the tool operation is straightforward, it can be tricky to get accurate readings from it. The digital reading can drift from the zero point even if the needle has not moved, as shown in figure 1b. As such, one can expect roughly +/- 5 μm of error in a reading. To minimize these effects, we recommend measuring etch depth differences on the scale of 100s of microns. For example, if the expected etch rate is around 15 $\mu\text{m}/\text{min}$, it is helpful to take readings after 10 minutes of etching such that the error has minimal effect on the calculated etch rate. If the zero point is reading much more than +/- 5 μm after placing the pin down when the sample is removed, rezero the gauge and redo the measurement.

It is also helpful to keep a reference to check measurements against. For example, we mounted our chips on a carrier wafer with a thick layer of SiO_2 . The carrier wafer would be etched minimally during our Si etch process, and we would observe no height change when measuring with the drop gauge. If taking multiple measurements on samples mounted to the carrier wafer, you can check the measurement on the carrier wafer to ensure that the drop gauge has not drifted too much as to affect your measurements significantly.

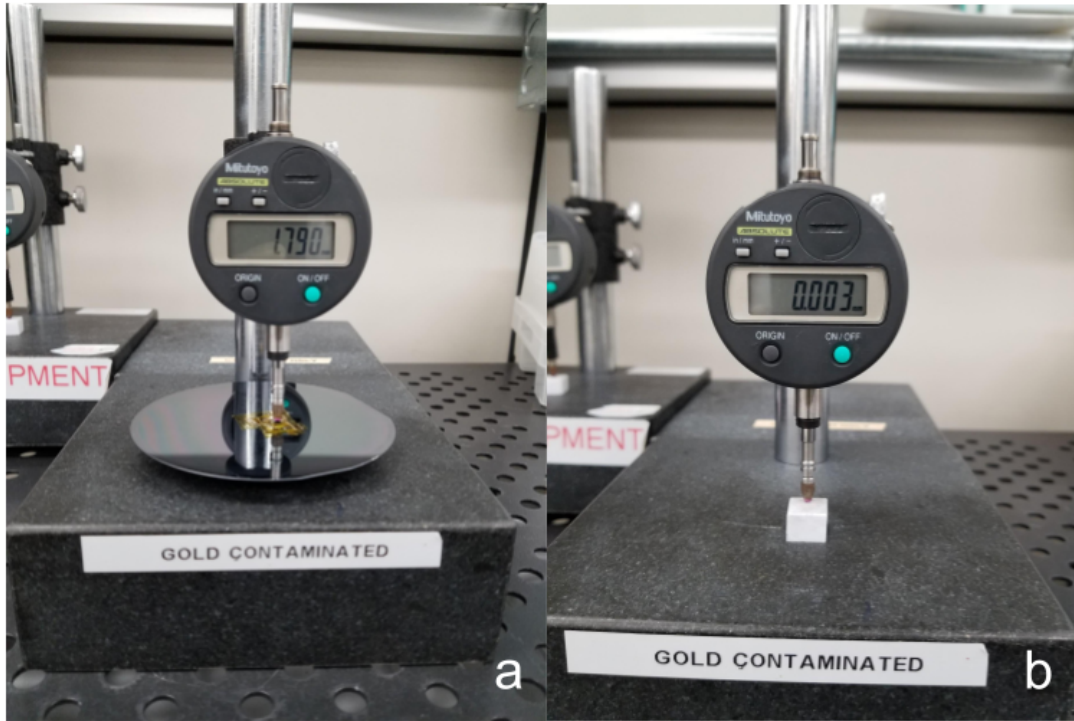


Figure 1. (a) Drop gauge measuring sample height of a chip mounted onto a carrier wafer, and (b) displaying drifting from the zero point despite there being no measurement done at this point.