

## NANONUGGET

Using the drop gauge to measure the thickness and compression amount of PDMS films

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The differential tabletop drop gauge is a hand-operated device that is straightforwardly used to measure the height of a surface with respect to a point of reference, with micron-level precision. One is available for use in SNF Exfab 159 Capitola, where the DISCO Backgrinder and Wafersaw are located. Although seemingly easy to use, a roadblock may be encountered in using the device for accurately measuring the thickness and compression amount of PDMS films. This *nanonugget* explains how to do so.

First, the standard instructions for how to use the drop gauge for rigid surfaces is outlined. Turn the gauge on by pressing on the green, right-most button. First, make sure that the drop gauge device is firmly attached to the steel rod that is screwed to the granite block staging platform. Do so by tightly screwing the plastic knob towards the back of the block.

**NOTE:** Skipping the screw tightening step can significantly affect your results, resulting in drifting as much as 5um.

Next, “zero” the gauge by pressing and holding the middle blue button until the gauge reads “0.000mm,” while the tip of the gauge is resting on the granite block. The drop gauge is now ready to use! Simply lift the pin, place the sample underneath, and then let the pin drop on the sample. To remove any air that may have crept underneath the sample upon placement, and to ensure that the pin settled well on the sample, tap the pin gently with your index finger a few times. Take the first value to which the gauge settles afterwards as the true reading. For samples with significant bow, it may also be necessary to push down on the sample with both index fingers in order to flatten the surface being measured.

Although drop gauge operation is seemingly straightforward, problems arise when trying to use it directly on a PDMS film, which is by nature compressible and damageable by the relatively sharp gauge pin.

To protect the film, use a small, 5mm X 5mm piece of cleaved silicon in-between the drop gauge pin tip and the PDMS film. Ensure that the polished surface of the piece is facing upwards and that the rougher surface is in contact with the PDMS, preventing surface-level bonding between the PDMS with silicon, which would make removal of the protective piece difficult. The protective piece distributes the force of the pin to an area instead of a point, both protecting the piece and giving more accurate measurements, as the height reading now comes from the surface of the PDMS film, instead of slightly below, to whichever height the sharp tip digs into.

To make the film thickness measurement, tap the pin several times and wait for the gauge reading to settle. (Of course, measure the thickness of the wafer before curing the PDMS on top, so that you can subtract it now to find the thickness of the film!)

To find how much the film can be compressed (in the absence of a force gauge), rest your wrist on the corner of the granite block, and gently but firmly push down on the pin, until the gauge itself moves ever so slightly downwards (this shouldn't take much force at all!). Record this value. Next, remove the sample and repeat this with no sample, on the granite block: with your wrist resting on the corner of the block, push down on the pin until the gauge moves slightly downwards. This is the base reading that you must subtract from the sample push reading to see how much the film can be compressed by. (A typical base reading ranges from -0.001mm to -0.004mm.) This is a handy way to compare how stiff different formulations of PDMS are!

**NOTE:** This process does not take much force! Pushing too hard can result in damage to the gauge tip or the granite block!

