

Semiconductor Cleaning for In-vacuum Applications

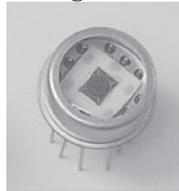
LIGO T1000091-v2

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1. **Overview and Background** – A cleaning procedure has been proposed for photodiodes that are to be placed directly in the aLIGO vacuum volume. An example of a photodiode (OSI Optoelectronics Q3000, InGaAs 3mm four quadrant diode) used for in-vacuum wavefront sensing and quadrant position sensing is shown in figure 1.

Figure 1



There is a glass window that separates the hermetically sealed inner volume from outside contamination. This glass window is to be removed for aLIGO in-vacuum photodetector applications. It is desirable to be able to clean the photodiode element and the inner portion of the can without damage to the semiconductor element.

2. **Procedure** – Must be performed in a class 100 cleanroom or on a class 100 laminar flow bench, with proper cleanroom clothing including mask, hair net and gloves.
 - 2.1. Clean exterior of diode can with isopropyl alcohol
 - 2.2. Allow diode can to dry
 - 2.3. Using a clean can cutting tool, cut the window off the diode (see section 3 for details)
 - 2.4. Using isopropyl alcohol in a squeeze bottle, rinse the interior of the diode can for 15 to 30 seconds
 - 2.5. Without drying off the diode, now rinse with DI water from a second squeeze bottle for 15 to 30 seconds
 - 2.6. Dry the interior of the diode with nitrogen
 - 2.7. Vacuum bake per normal process at **100 degrees C**.

During the washing phase, don't allow the diode to dry. This will prevent the dissolved contaminants from re-depositing on the semiconductor surface.

3. **Cutting the glass cover off the can**
 - 3.1. Visually inspect the Thorlabs can cutting tool to ensure the rollers are firmly attached, the cutting blade is sharp and properly aligned with respect to the tool, and no obvious damage exists
 - 3.2. The cutting tool can be configured to accommodate different diameter cans. Make the necessary adjustments to the tool's rollers such that the can fits the tool.

- 3.3. Place the diode into the cutting tool with the leads protruding away from the cutter. The cut should be made about half way up the can of the diode.
- 3.4. Adjust the black depth-stop screw until the cutter blade can barely touch the can of the diode. Increments to this screw should be made in no more than 1/8 of a revolution steps.
- 3.5. Apply **gentle** pressure to the cutter and rotate the knob to score the diode. Once the cutting has ceased, increment the depth stop by ~10 degrees or so. It may take 100 or more turns and many depth-stop increments to fully cut the diode. At all times, be prepared for the diode to fall. A soft landing place is a must. Take your time this is a critical step.
4. Once the tool cuts through the diode, gently remove the glass window if it is still attached. Be extremely careful of the exposed diode element. Visually inspect the diode element for damage.