

## Cleaning Optics in Preparation for Coating

Cleaning in preparation for coating is a more challenging task than cleaning already-coated optics. Of primary concern is the adhesion of the soon-to-be-deposited film. Additionally, any stains or contaminants on the optic will be more visible and impossible to remove after coating. The first step in cleaning as-fabricated optics should be either an abrasive scrub or a chemically enhanced ultrasonic cleaning.

For an abrasive scrub, typically a ceria or alumina-based compound is used. Umicore's "Substrate Cleaner" (ceria) or Baikowski brand alumina grit is recommended. Ceria based polishes work especially well on glass due to the extra "chemical tooth" of the ceria, and alumina-based polishes work on just about everything else due to their high hardness. The purpose of the scrub is to remove the outer layer of substrate material, taking with it all contaminants.

Ultrasonic cleaning can also be used – cavitation in ultrasonic cleaners physically ablates the surface of the optic, and in conjunction with the chemical action of specially designed surfactants and cleaning agents, one can essentially achieve the same effect as an abrasive scrub. Care must be taken with ultrasonic chemistry, as the cleaning agents that work well for one material may rapidly degrade other materials.

Following any sort of chemical cleaning, at least one fresh DI-rinse is necessary to remove all remaining contaminants. Many ultrasonic cleaning lines come with forced-air dryers. Their use is not recommended. Both with ultrasonic cleaning and an abrasive scrub, it is recommended to keep your parts wet until the final wipe stage.

Final wipe should be preceded with a solvent quench. In addition to the cleaning action that this provides, it pulls the remaining water off the optic due to the difference in surface tension between the water and the solvent. IPA is recommended for this quench. It is important that local laws and guidelines be followed when using and disposing of isopropanol.

Final wipe proceeds as described above under high-intensity lighting. Parts can now be considered clean enough for coating and should not be stored for more than two hours, as even the cleanest of parts in the best of cleanrooms will adsorb contaminants from the ambient environment over time.

## Preparing Optics for Coating

Reynard Thin Film Coatings are durable and robust, but care must be taken to clean the optics only when necessary to avoid any damage. The preferred method for cleaning coated optics is a solvent drag wipe.

The first step is to identify a suitable wiping material for your precision optics. Reynard recommends Kimberly-Clark “Kim wipes” Delicate Task Wipes, which are widely used in industry for this purpose. Cotton tipped swabs may also be used. Be sure that whatever wipe you choose is free from contaminants (such as lotions that can be found on some tissues) and large inclusions (such as wood pulp).

The next step is to identify your solvent. High purity acetone, isopropanol or de-ionized water can be used. Reynard recommends the use of acetone in conjunction with isopropanol for most applications. The three solvents have vastly different properties and selecting the proper combination will greatly affect the effectiveness of your cleaning efforts. Acetone tends to evaporate the fastest, followed by isopropanol, and then DI water, therefore controlling the rate of evaporation with respect to wiping speed is important, as detailed below. Additionally, some organic contaminants are removed effectively only with acetone (such as photoresist) whereas others are removed most effectively with DI water (such as dried saliva).

The proper drag wipe technique is to place several drops of solvent onto your wipe and to drag it across the surface. This process should involve only shear forces – no force should be applied normal to the optic. The shear forces of the dragging and the surface tension of the solvent are all that is needed to remove contaminants from your optic. The proper wiping speed will produce a very short trail of evaporating solvent. If the trails persist after wiping, or are not visible at all, the wiping speed may be too fast or too slow. A short trail ensures you are getting mass transfer across the surface.

It is worth noting that the use of canned air should be avoided. Ejection of the liquid phase of the canned air can cause staining that is difficult to remove. Airborne contaminants can also become entrapped in the gas flow and be propelled onto the surface of your optic. If gas-based cleaning must be used, filtered dry nitrogen is recommended at pressures of approximately 10psi.