

UV- and plasma cleaning diffraction gratings

We measured efficiency of a UV ozone-scrubbed and plasma (nitrogen) cleaned replicated diffraction grating. For the test part, reflected diffraction efficiency measurements improve with each cleaning, overall 12% improvement on average. Scanning electron microscope (SEM) images of the optical surface do not indicate structural change or damage.

Despite the title of this post DO NOT ATTEMPT TO CLEAN YOUR DIFFRACTION GRATING! We're reporting work done under controlled circumstances with the VUVAS vacuum UV analytical spectrophotometer that measures transmission, goniometric reflection and diffraction efficiency. It works to wavelengths short as 120 nanometers using vacuum or inert gas (nitrogen) purge. For best stability, we work with nitrogen purge. For windows and other samples, we've also been UV scrubbing and plasma cleaning for better measured results. The cleaning techniques combined with strict operating procedures provide opportunity to measure the real surface – not one changed by exposure to ambient humidity or other factors. Cleaning techniques have become very important in the deep UV, where results are usually improved.

With UV ozone-scrub and plasma cleaning together or separately, measured diffraction efficiency improved. Approximately 10% improvement was measured, across the board, after the cleaning sequence. Scanning electron microscope (SEM) images from a Phenom Pure show no change to groove profile or surface of the diffraction grating.

We do not recommend or normally attempt to plasma clean reflective optics. At this time, this series of tests is an exception. In the plasma cleaner, we've frequently seen coated surfaces behave like a dielectric and create an arc or discharge causing damage to coatings. During this series of tests and cleaning-cycles, no arcing occurred.

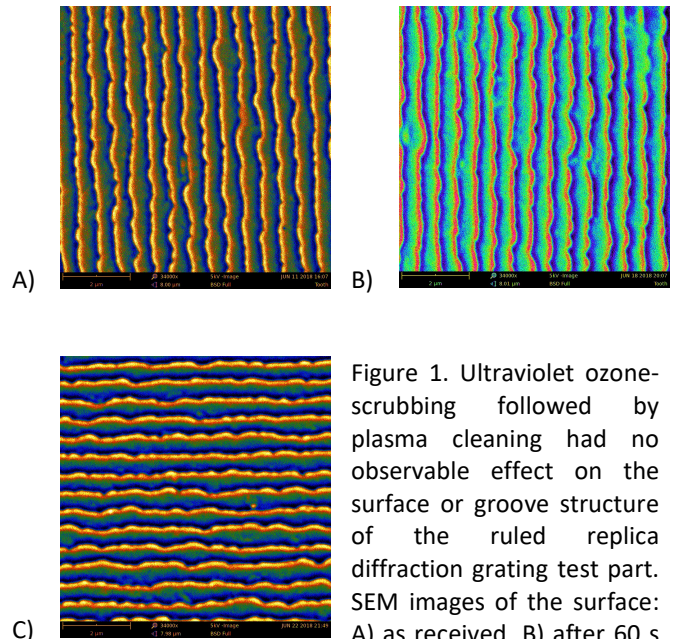


Figure 1. Ultraviolet ozone-scrubbing followed by plasma cleaning had no observable effect on the surface or groove structure of the ruled replica diffraction grating test part. SEM images of the surface: A) as received, B) after 60 s ozone scrub, C) 60 s ozone scrub and plasma for three 60 s exposures. Arbitrary colors and groove direction

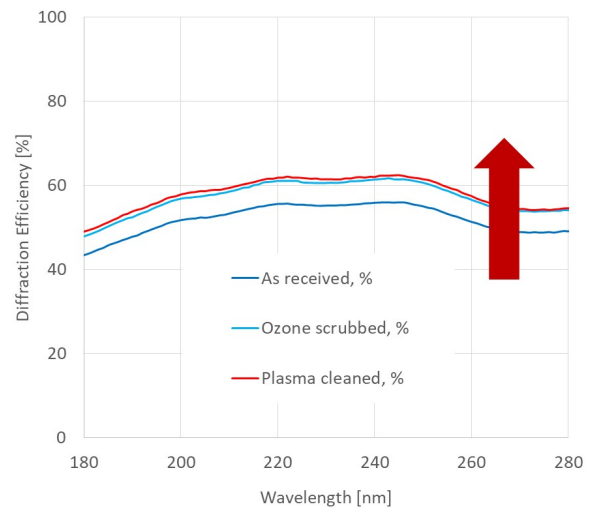


Figure 2. UV ozone-scrub and plasma cleaning improve measured diffraction efficiency