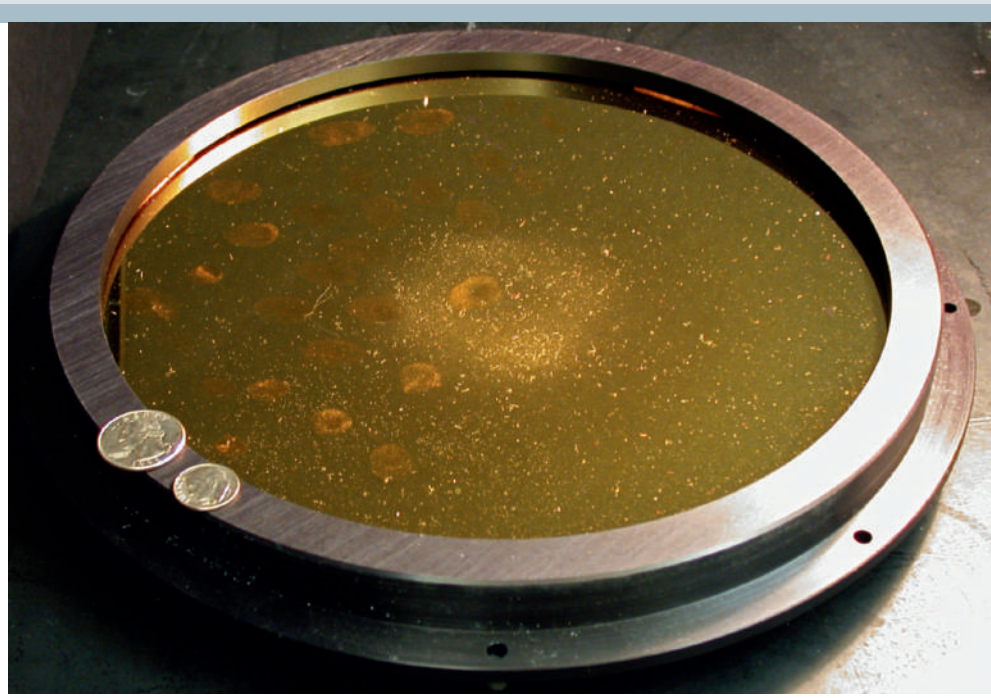

Optics restoration

FIRST CONTACT LIQUID POLYMER RESTORES SENSITIVE OPTICAL SURFACES TO ›AS NEW‹ CONDITION

Cleaning and protecting a wide range of optical surfaces is now not only feasible, but significantly more cost-effective and time efficient than standard methods. ›First Contact‹ liquid polymer enables cleaning and protection of precision optical surfaces such as the nearly impossible to clean ›first surface‹ mirrors, sensitive IR optical coatings, and all coated optics.

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Optics get dirty. It is inevitable and the effect on your work can range from annoying to extremely costly. The methods of cleaning accepted until now have been drag wiping, solution dips/washes, dry ice snow cleaning, compressed air/nitrogen sprays, or swearing at the colleague who decided it would be a good idea to add a thumb print to your primary mirror.

While some of these processes use inexpensive supplies, the lost time spent cleaning can add up quickly, potentially cause damage and may not successfully clean the optic. All of these methods often require the optics to be removed from the mounts and often simply spread the dust around without actually removing it. These last frustrations are what spurred development of a special polymer in the late 1980's in order to provide a new solution to an old problem.

First Contact

The ›First Contact‹ polymer was originally developed to clean gold and aluminum mirrors as well as YAG laser oscillator cavity mirrors *in situ* and without requiring post-cleaning re-alignment. The simple to use liquid polymer is painted or sprayed on an optic, dries in a few minutes to a thin plastic film, and then is slowly peeled off, leaving the surface pristinely clean (Figure 1). The polymer comes off in one piece without tearing and removes all contamination – even at a molecular level.

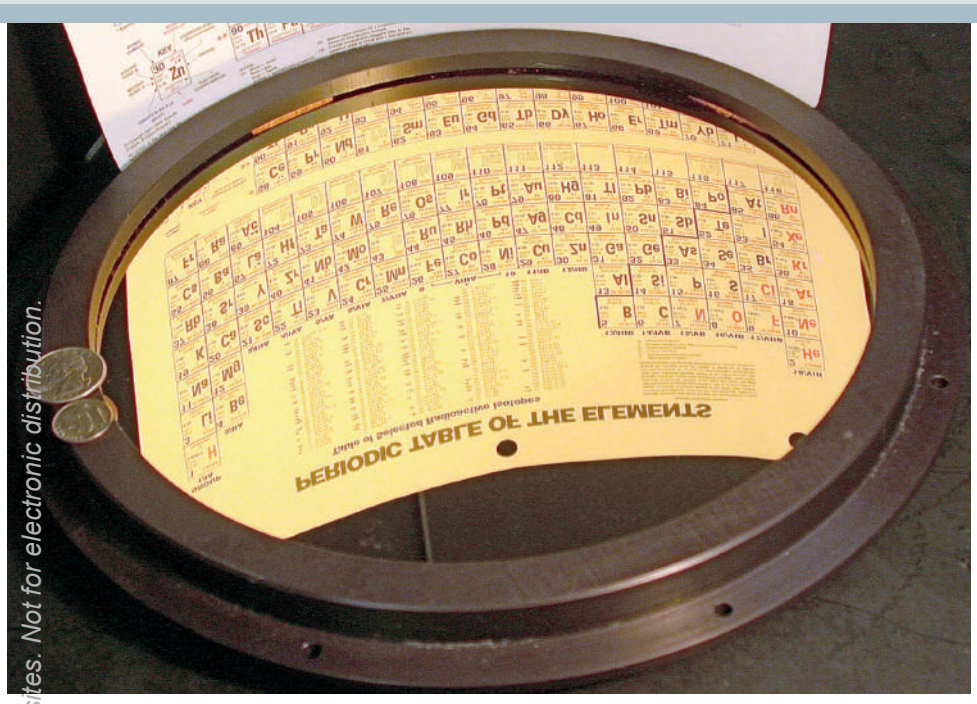
First Contact polymer has since evolved a long way from its humble beginnings. Nearly twenty-five years later, it has been optimized, extensively tested and proven to be effective, and is now used by many large organizations in the optics, astronomy and defense industries.

Proven cleanliness

Procedures and recommendations described above on how to care for and clean optical surfaces had not changed much in the last 400 years. Now, the use of First Contact polymer shows far superior cleaning results on a myriad of surfaces while remaining cost effective and time efficient when compared to standard cleaning methods. Independent studies by NASA, JPL, Lockheed andLIGO as well as other published studies have clearly demonstrated that First Contact Polymer's cleaning capabilities are superior to conventional cleaning methods such as drag wiping and dry ice snow [1]. Compared to cleaning with acetone or alcohol, for example, significant improvement in reflectivity for optical surfaces is achieved.

One of the benefits of First Contact polymer films is that once contaminates have been removed, they stay off (Figure 2). This is in stark contrast to dusting, spray cleaning with compressed gases or dry ice snow where contaminates

1 First Contact's polymer film is simply peeled off



are blown into the air, only to redeposit onto whatever surface lies in the area. Optical practitioners know that the amount of residue left by drag wiping or conventional protective strip coats is significant and can be seen with the naked eye. With First Contact polymer, no residue that caused scattering was found [1] and BRDF (bidirectional reflectance distribution function) measurements show much cleaner surfaces than for drag wiping [2]. Multiple surface chemical analysis studies by x-ray photoelectron spectroscopy [3] have shown no molecular residue remains. First Contact polymer is also listed on the NASA ›Outgasing‹ website and, once dry, is compatible with vacuum chambers and aerospace applications [4].

Don't touch

'Never touch an optical surface' is the usual mantra taught in optics, as contact (a thumb print or a scratch) is the best way to destroy expensive optics and gratings. First Contact polymer is an exception to this rule, as it causes no damage to optics and can be used on a wide range of surfaces, from gold plated mirrors (**title image**) to gratings to frosted surfaces. The polymer, once dry, has strong adhesion to itself and to contaminates on the surface, but very little adhesion to the surface itself (roughly 10 percent the adhesion of scotch tape). It is thus safe on almost all substrates and coatings and can even be used as a pre-cleaner prior to coating, resulting in fewer pinholes and better coating adhesion [1].

Nonetheless, silver, gold and IR coatings as well as some diffraction gratings are notorious for having weak adhesion, and occasionally a coating will be completely removed by the polymer on an optic with a poorly prepared surface. Consequently, it is always recommended to test on a corner or old optic before cleaning the center of your primary mirror.

Unparalleled protection and ease of use

Shipping and transportation are often seen as weak points where dust, abrasion, fingerprints and moisture can ruin brand-new optics or cause conflict between manufacturer and customer. Extreme measures are often taken in transport and shipping of optics, such as using expensive packaging and vacuum-sealed containers, placing lense tissue or plastic sheets on the surface. As a protective coating, First Contact completely protects from contact and scratching. Once dry, it is also an excellent barrier to moisture and sulfide contamination. Shipping costs can be drastically reduced by simply applying the polymer and eliminating all the work and equipment required for vacuum sealing.

The costs of maintaining or recoating optics can be daunting. Whether the processes involves completely re-surfacing an optic or just taking the apparatus apart to do a drag wipe, the time and resources consumed can be significant. Technicians must be highly trained on the procedures and have a working knowledge of the system they are taking apart or assembling. In contrast, First Contact requires minimal training and time, and optics can be cleaned *in situ*, vertically or upside down. Optics protected by First Contact can even be installed in hard to reach places, and the polymer can be removed after assembly and once the surface no longer requires protection.

Lastly, First Contact polymer is a workspace safe and environmentally friendly non-toxic polymer blend mixed with common solvents. It has a RoHS certification and is exempt under the Air Quality Management District rules in Southern California, the most restrictive rules within the United States. Once dried, the polymer is completely inert and can be disposed of in normal trash.

A polymer for the future

The original colorless version of the polymer is still available, but a newer red polymer has many advantages. While not losing any cleaning capabilities and maintaining the no outgassing and zero residue attributes of the clear polymer, the red polymer dries one third faster, has less adhesion to gold surfaces and the red color makes it easier to ensure coverage of the entire surface. This is the recommended version for most uses. There is some static charge caused by the peeling force of the polymer, but if static charge is of concern, ›First Contact DF‹ is available and very effectively dissipates static build-up on peeling. This DF version has been tested on back-illuminated astronomical sensor devices (CCDs) and has even cleaned vacuum pump oil from a chip face [5].

Although the current First Contact solvent formulation dissolves and damages some plastics, a new formula is in the end stages of development that is safe for plastic optics.

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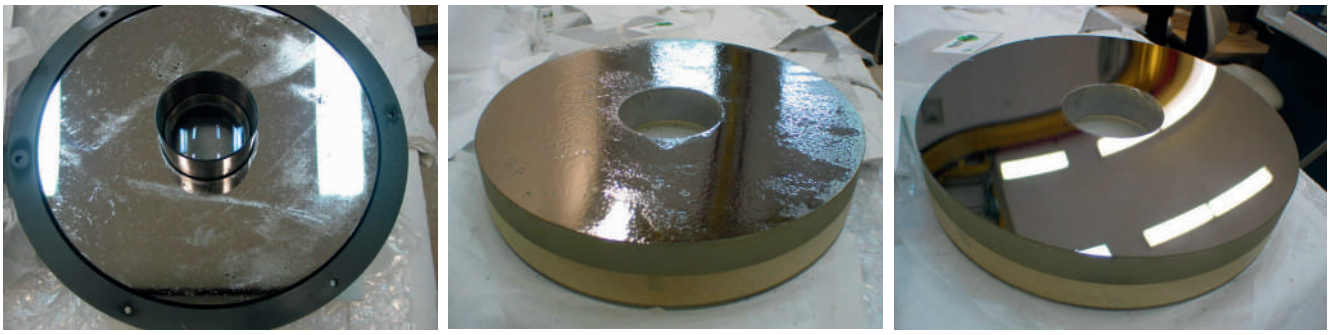

2 Use of First Contact polymer on an astronomical mirror: dirty (left), coated (middle) and cleaned (right)

Summary

First Contact polymer has enabled cost effective and time efficient systems to clean ›first surface‹ mirrors as well as a wide range of other optical surfaces. The system requires minimal training and is very safe for people and equipment alike. With the variety of polymer's available, nearly any optic can be revitalized to like-new condition with zero residue.

REFERENCES

1 For example: Wilson, R.N.: 'Reflecting Telescope Optics II', Chapter 6, Springer Verlag, 1999, pp. 442-448

2 Ligo Document Control Center, Dokument LIGO-T1000137_v1 (*https://dcc-lho.ligo.org*)

3 XPS Studies: Bennett, J. and Ronow, R., Applied Optics 39 (161), June 2000

4 NASA Goddard SFC, Code 541: 'Chemical Analysis Report', Analysis Number: MATG 3179, Swales Aerospace, JPL Analytical Chemistry Laboratory, LIGO-T060051-00-D, 2006 (*https://dcc.ligo.org*)

5 Derylo, G. et al: 'Surface cleaning of CCD imagers using a electrostatic dissipative formulation of First Contact', Proc. SPIE 7018, 701858 (2008)

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