GOLD COATING

Uses of gold coated mirrors

Electroplated gold coating has excellent and consistent reflectivity in the infrared and good reflectivity in the visible, which allows the easy use of visible alignment lasers. Unlike vacuum deposited gold coatings, our electroplated gold never peels, flakes or delaminates.

Polarisation changes to the laser beam on reflection are virtually zero, so for metal cutting and other polarisation sensitive applications, gold mirrors are the most reliable way of maintaining polarisation. Because reflectivity is almost independent of angle of incidence, gold is an excellent choice of coating for scanner mirrors or for mirrors used at varying angles of incidence - collimator mirrors for example.

Electroplated gold coating is in intimate thermal contact with the mirror substrate so localised burns, dust and scratches have little effect on the mirror's performance - ideal for high power carbon dioxide laser cutting.

Electroplated gold is widely used with Er:YAG lasers, CO_2 lasers, QCLs, OPOs and many other applications in the infrared from 1-300 microns wavelength, including terahertz imaging.

Benefits of gold coating

Our gold coating covers all the mirror surfaces - front sides and rear - so there are no discontinuities that can initiate delamination of the coating. Cassegrain reflectors and Herriott cells use our gold coated metal mirrors because the through holes in the mirror are also gold coated. The coating will withstand typical medical sterilisation procedures.

Chemically deposited gold coating has a huge laser damage threshold. With a copper mirror substrate, gold coated mirrors will withstand 40 Kw. Gold mirrors need careful cleaning, see our technical documents on the subject of cleaning laser mirrors and contamination, available on our website.

There is a strong technical and economic case for using gold mirrors as beam delivery optics. A survey of used MaxR coated mirrors from different suppliers has shown that most mirrors after just a short time of use, even if 99.8% reflective when new, are typically 98% reflective in operation.

LASER DAMAGE

LBP Optics in partnership with UK and European Universities have investigated the causes of laser damage and measured the Laser Induced Damage Threshold (LIDT) of many CO_2 laser optics. This work has been published by SPIE.

Proc. SPIE Vol. 3244, p. 188-198, Laser-Induced Damage in Optical Materials: 1997, Gregory J. Exarhos; Arthur H. Guenther; Mark R. Kozlowski; M. J. Soileau; Eds.

Proc. SPIE Vol. 2714, p. 281-281, 27th Annual Boulder Damage Symposium: Laser-Induced Damage in Optical Materials: 1995, Harold E. Bennett; Arthur H. Guenther; Mark R. Kozlowski; Brian E. Newnam; M. J. Soileau; Eds.

Laser damage threshold

The most important result from this investigation is that copper based mirrors and ZnSe lenses in a typical industrial laser operate at a fraction of their Laser Damage Threshold.

The reason(s) optics fail is entirely due to external factors, e.g. from their operating environment.

In particular, mechanical forces from mounting, clamping etc significantly reduce the lifetimes of ZnSe lenses. Increased absorption from external contamination or poor cleaning can quickly lead to laser damage. The difference between a good lens and a poor lens, can be an increase in absorption of just 1 part per thousand.

Fortunately, the situation with copper mirrors is more forgiving, as their ability to sink heat is so much better.

Gold coated copper mirrors are used on lasers of 40 KW power. For 3 KW laser power or higher, copper mirrors are the only realistic choice. Such a large power handling ability means that even when damaged or dirty, copper mirrors carry on working in high power industrial laser systems.

For a laser with a 20mm beam diameter gold coated copper mirrors are working at just a fraction of their potential – see the table below.

Laser Power	2KW	4KW	5KW	20KW
Fraction of Laser Damage Threshold	2%	5%	6%	25%

The correct parameter for expressing laser damage threshold of CW CO_2 laser optics is the ratio "P/d" where P is the laser power in Watts and d the diameter of the beam in mm. For a gold coated copper mirror the P/d value that damage occurs at is 4000 Watts per mm. So to cause laser damage to a gold coated copper optic a 4000W laser would have to be focussed to a spot 1mm in diameter on the mirror surface. This law is a “scaling law”, so 8000kW in 2mm diameter has an identical P/d value, i.e 4000W/mm.