

Introduction

The output coupling mirror and the rear mirror are the key optical components of the laser resonant cavity, both are part of the laser generation process. The transmissive mirror is usually used as the laser output coupling mirror. And the high reflectivity (HR) mirror with reflectance of 99.5%-99.7% work as the rear mirror.

Reflective mirror

The reflective mirror is an important element in the laser resonant cavity, such as in the CO₂ laser light path. The mirror in the laser cavity can be used as a rear mirror with a certain curvature, to play the role of oscillating laser beam. in some laser designs, the reflective mirror can also be used to reduce the length of the laser tube. The reflective mirror generally uses molybdenum and silicon as the substrate. Molybdenum mirrors can work in harsh environments and have a long service life time, withstanding high power, do not require surface coating and are resistant to wiping, however, it has the disadvantage of low reflectivity. Monocrystalline silicon is a cost-effective substrate material with good optical thermal properties.

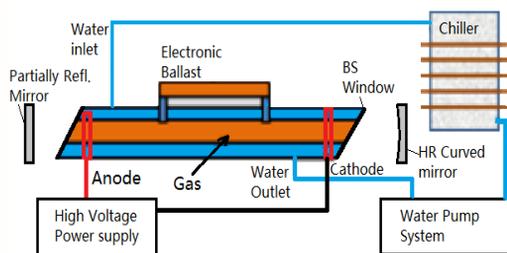


Fig 1. The principle of CO₂ laser optical cavity

Key parameters of reflective mirrors include: surface flatness, surface finish, roughness, absorption, laser damage threshold, group delay dispersion (GDD) and the reflection/transmission ratio, etc.



Fig 2. YAG cavity optics

1. Ultra-high reflectivity mirror

- Reflectivity: 99.9%-99.99%
- Surface Finish: better than 20/10
- Surface flatness: better than 1/8 λ
- Roughness: better than 3A (Ra)

2. Partial reflective mirror

- Reflectivity: 1%-99%
- Surface Finish: better than 20/10
- Surface flatness: better than 1/8 wavelength
- Roughness: better than 3A (Ra)

3. Chirped Reflective mirror

- Rs & Rp > 99.8%
- GDD from -50 to -1000 fs²
- High damage threshold

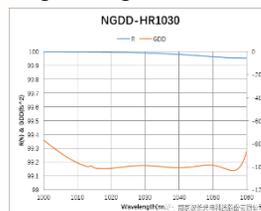


Fig 3. IBS coating curve (left) and equipment (right)

Thin film

Optical thin film is an important part of laser system. In the resonant cavity of high power laser, the limited value of its reflectivity prevents further increase of the laser output power. Therefore, it is especially critical to improve the reflectivity of the HR film. Wavelength Opto-electronic(s) Pte. Ltd has the processing equipment and testing capability of IBS vacuum coating. The so-called IBS is known as Ion Beam Sputtering coating or method in which the ion emitted will be further induced, accelerated, focused to become a beam. A target plane in high vacuum will be bombarded with this ion beam, and the sputtered atoms will form the coating film.

The advantages of IBS vacuum coating:

- 1、 Better process control
- 2、 Coating design with wider choices
- 3、 Improved surface quality and less scattering
- 4、 Reduced spectral drift
- 5、 Thicker thickness of coating in a single cycle
- 6、 Reflectivity can reach 99.9%-99.99%



For the rear reflective mirror, the increase of its reflectivity not only can increase the output power and improve the quality of the laser beam but can also increase the damage threshold and reduce the thermal distortion of the cavity mirror. With further increase of high power COIL output power, the traditional design film system has gradually failed to meet the requirements. We have designed a new highly reflective film system, which greatly reduces the thickness of the high refractive index layer compared with the traditional design film system, making it possible for the damage threshold of the film system to be greatly improved.

Conclusion

As a global enterprise, leading photonics innovation since 2002, WOE is a professional laser optical components supplier, not only provides laser cavity reflective mirror, polarization beam splitter (PBS), but also can provide focusing lens, F-theta scan lens, telecentric scan lens, beam expander, laser welding head, and other laser components.

