

Introduction

Highly and partially reflective mirrors are the key optical components in the laser resonant cavity. The partially reflective mirror is the output coupler of the cavity while the highly reflector mirror usually has a reflectance of usually larger than 99.5%.

Reflective mirror

The high reflector and output coupler mirrors usually have a certain curvature to play the role of oscillating laser beam, such as in the YAG laser cavity. In some laser designs, the reflective mirror is also 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 the advantages such as long life time, withstanding high power, no surface coating needed and wiping resistance. However, its reflectivity is low. Monocrystalline silicon is a cost-effective substrate material with good optical thermal properties.

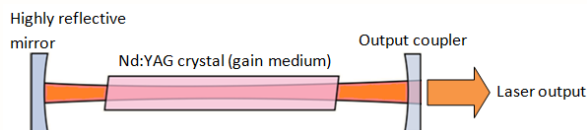


Fig 1. The schematic diagram of Nd:YAG solid-state laser optical cavity

The reflective mirrors have the following key parameters to be considered: surface flatness, surface finish, roughness, absorption, laser damage threshold, group delay dispersion (GDD) and the reflection/transmission ratio, etc.

1. Ultra-high reflectivity mirror

- Reflectivity: 99.9%-99.99%
- Surface Finish: better than 20/10
- Surface flatness: better than $1/8 \lambda$
- 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

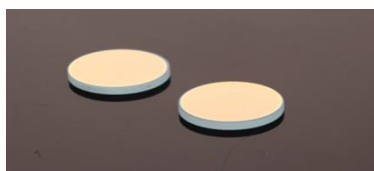


Fig 2. YAG cavity optics

Wavelength Opto-electronic(s) Pte. Ltd. (WOE) can provide a variety of reflective mirrors to meeting different laser cavity requirements.

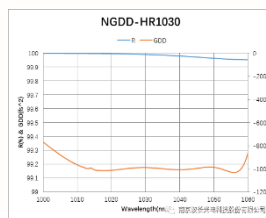


Fig 3. IBS coating curve (left) and equipment (right)

Thin film

Optical thin film is an important part of laser system. In the resonant cavity of high power laser, the limited reflectivity prevents further increase of the laser output power. Therefore, it is critical to improve the reflectivity of the high reflectivity (HR) film on the mirror. WOE has the production and testing capability to provide high quality Ion Beam Sputtering (IBS) vacuum coating. IBS accelerates and focuses the ions from the source into a beam and sputter the target material surface to form a layer of 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 output coupling mirror, the damage threshold of the reflective coating becomes critical when the output power is high such as chemical oxygen iodine (COIL) laser. 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.

