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High Power, High LIDT Laser Optics - Understanding Optics for-High Power Lasers

Catalog optics are fine for many laser applications but high power lasers require specified damage optical characteristics. The whitepaper explores power resilience of laser optics, working with test laboratories, ISO testing, measuring LIDT, LIDT and pulse duration, laser damage causes and best practices to achieve high LIDT coatings, designing new coatings and maintaining standards. Understanding and controlling LIDT is fundamental to ensuring the optimization of high power laser systems.

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High Power, High LIDT Laser Optics Understanding optics for high power lasers

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INTRODUCTION

All of us who work with power lasers have experienced laser damage, usually when we least wanted to. That flash of light in our darkened filing lab or audible "pop" signals that the day has just got a bit longer. Catalog optics are fine for many laser applications but high power lasers require specified damage characteristics of their optics.

Laser Evolution

A meteoric expansion of laser applications has resulted in lasers becoming more and more powerful. Laser applications range from space photonics down to the more terrestrial based life sciences and surgical tools. The technology responsible for enabling this expansion is optical coating technology. Basically, this means there can be no increase in laser power if the component coatings are not up to the damage threshold required and in the past decade there has been a step function upgrade in coating technology using low defect techniques for deposition, substrate polishing, substrate surface purification and cleaning. Many of these highly controlled clean technical techniques were initially developed for microelectronics fabrication.

What is Coating Technology?

The highly transparent plate glass in windows can be made totally reflective by applying a metal coating to it. Architectural plate glass changes from near totally transparent to totally reflective by applying a metal coating to it.

Sadly, metal coatings have very low damage thresholds so all power lasers contain dielectric mirrors. However, there are 2000s of different types of dielectric coatings, changing properties of the substrate to anti-reflective (AR), highly reflective (HR), all manner of partial reflectivity, polarizing optics, long and short pass filters and many more. Most substrates are glasses but crystal substrates are also used for waveplates and non-linear optics for frequency doubling and tripling. Moreover, all the above are available in a plethora of wavelengths that can range from the UV out to 10 μ m and beyond.

Coatings are seldom a single layer. Complex filters can have many 10s of coatings applied to specify their application. Coating technology is highly advanced and jealously guarded as all advances have come with a high price tag due to the complexity of the amorphous nature of the coating.

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