Smarter lens marking with the 193 nm excimer laser: a single solution to meet the demands of a changing market

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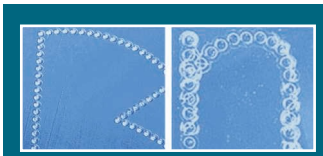
With spectacle prices for designer frames and accompanying high-index coated polycarbonate lenses or mineral glasses reaching into hundreds of euros, opticians and their customers are increasingly concerned with confirming the provenance and quality of the products delivered. This issue is made worse by the ever-increasing number of non-genuine copycat products available to consumers today. Laser engraving is one remedy that manufacturers are employing to defeat counterfeiting and protect the value of their products and the good name of their brand. In addition, they are providing a positive assurance of quality to their end customers. With a number of different laser engraving technologies available for this task, it might be easy to assume that for this particular purpose, a mark is a mark. However, nothing could be further from the truth.

The quality of the mark varies widely depending on the laser technology—this is just the simple physics of light at work. Product offerings vary in wavelength from infrared (IR) to ultraviolet (UV), each having certain advantages. In the past, a comparison of IR and UV tools for this purpose would have yielded a considerable gap in cost. Now—with the incremental improvements in the costs of acquisition and operation afforded by the latest generation of 193 nm excimer laser, such as the Coherent ExciStar (figure 1)—there is cost parity with longer wavelength CO_2 and diode-pumped solid state (DPSS) laser-based solutions, as well as superior quality and throughput of the marks.

Two decades of the eye care industry utilising excimer lasers to mark ophthalmic lenses made from mineral glasses or lightweight plastics have demonstrated their reliability, ease of operation and applicability for high-volume processing. Several hundred excimer laser marking systems have been deployed worldwide by ophthalmic manufacturers producing best-in-class visible, invisible and technical marks, all of which are free from thermal damage (figure 2).



▶ Figure 2: Engravings in mineral glass using the 193 nm ExciStar laser at a spot size of 40 µm (left image) and a q-switched pulsed CO_2 laser at a spot size of 120 µm. The CO_2 laser mark shows thermal effects due to the longer wavelength, including uncontrollable microcracking. ▶

▶ *Figure 1: ExciStar is designed for seamless system integration, serving a broad range of precise engraving tasks such as ophthalmic lens marking or optical sensor manufacturing.* ▶

On the throughput side, excimer laser pulse repetition rates of up to 1,000 Hz, as provided by the ExciStar, translate into permanent defect-free marking speeds as high as 200 ophthalmic lenses per hour. Since this engraving process is much faster than the other lens production steps, each excimer laser engraving system can support many grinding and polishing workstations.

The perils of compromising engraving quality

A company logo engraved in an eyeglass lens unmistakably identifies its manufacturer and provides a guarantee of quality. An eye glass manufacturer contemplating cutting costs by opting for an inferior, longer wavelength engraving laser technology overlooks that he puts nothing less than his brand equity at stake.

Brand-conscious consumers are a discerning crowd. The assurance of authenticity, as provided by a unique production mark, gives them the confidence that their hard-earned euros were well spent. As spectacles are no longer seen as a ticket to becoming the class nerd but are an owner's fashion statement and often a status symbol, a premium-quality brand logo engraving using the 193 nm laser wavelength is more than just a desirable extra. It becomes the calling card of the lens manufacturer (figure 3).

An excimer laser system is a technological one-stop solution

Not only can the excimer laser provide premium quality engraving of the brand logo, it also outperforms other alternatives when it comes to the low-to-medium quality engraving of other functional marks, such as a unique device identification (UDI) coding. Some manufacturers have been tempted to implement mixed technology solutions for these purposes. However, maintaining and switching back and forth between different laser technologies for similar purposes presents inherent difficulties, not the least of which is material applicability. As has already been seen, IR radiation is a clear underperformer when it comes to transparent material. Excimer lasers, by virtue of short wavelength and wide energy density range, provide a one-step solution for high-class permanent marks in transparent polymers (figure 4) as well as in all types of glasses and also contact lenses.

▶ *Figure 4: Technical engraving of 80 µm diameter spots in transparent polymer material shows the superior quality obtained using the 193 nm excimer laser. The width of each spot is slightly larger than the width of a human hair.* ▶

While the economic advantages of reducing the number of employed technologies (for example, spare parts) are obvious for a manufacturer, increasing requirements for prevention of brand counterfeiting and compliance with new governmental directives demand a high degree of process flexibility. Excimer laser systems at 193 nm comply with these conditions as well as simultaneously provide a technology bridge to future demands, whether that is a more sophisticated mark or a new material challenge.

▶ *Figure 3: A spectacle lens held at the appropriate grazing angle can easily be inspected by the wearer; the mark design, position and quality are assurances of the authenticity of the product. Under normal viewing, the mark is invisible.* ▶

The competitive edge with excimer laser technology

Obtaining the highest quality optical engraving on virtually all ophthalmic materials can be solved with a single laser technology, without a cost penalty. The introduction of the latest generation of 193 nm ExciStar lasers from Coherent has collapsed the gap in operational costs when compared with low- and medium-quality laser marking technologies. With a cost of operation reduction for the latest ExciStar model delivered by longer maintenance cycles and a threefold tube lifetime improvement, ophthalmic manufacturers can expect more than five years of worry-free operation in a typical three-shift lens marking environment. Given the other advantages of UV processing over IR, the excimer solution is the clear choice for bringing the future into focus. ●

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