December 2, 2021

SCHOTT Optical Wafers

Creating Tiny Optics with Big Performance

Introduction

SCHOTT Academy of Optics is a free, online seminar series designed to take your industry knowledge and expertise to new levels.

Throughout the series, you will learn from leading glass and material experts as they cover various topics pertaining to the optics industry.

Visit our website for more information or to register for an upcoming seminar: www.schott.com/trainings/academy-of-optics

For consumer electronics such as smart phones and augmented reality glasses, size and weight matter a great deal. This is driving a trend toward smaller, lighter optics, which are often made using wafer-based processes. SCHOTT offers a broad portfolio of glass substrates and wafers to meet the needs of this market while also having the proven global manufacturing capabilities for producing high quality wafers at the high volumes required for consumer applications.

1. Making optics smaller

Most tasks traditionally achieved with bulk optics can now be performed with miniature optics that measure in the nano- or micro-meter range. Because these tiny optics are made on very flat, thin substrates, they take up significantly less space, use less material and cost much less than traditional optical components. Nano and micro-optics are made on large wafers using well-known manufacturing techniques from the semiconductor industry. Fabrication techniques such as nanoimprint lithography, e-beam lithography and reactive ion etching can be used to make thousands of optical components on a single wafer.

Today, miniaturized optical components are used in many devices. For example, arrays of microlenses are used in projectors to collimate several light sources. Optics based on nanostructured surfaces called diffractive optical elements are used for facial recognition in many smartphones. Also, tiny, lightweight waveguides are being used to make augmented reality devices less cumbersome.

2. The importance of flatness

When creating optics using wafer-based fabrication methods, the flatness of the wafer is important. For the waveguides that transfer images in augmented reality devices, flatness is important for creating a crisp image. Wafers that are not completely flat can create a wedged-shaped waveguide that causes the light reflections inside to be uneven and changes the angle of the light leaving the waveguide. This reduces the modulation transfer function and degrades image quality. The effect is intensified if multiple wafers are stacked together. Thanks to their flatness, SCHOTT's wafers can be used to create waveguides that produce high quality images with an excellent field of view.

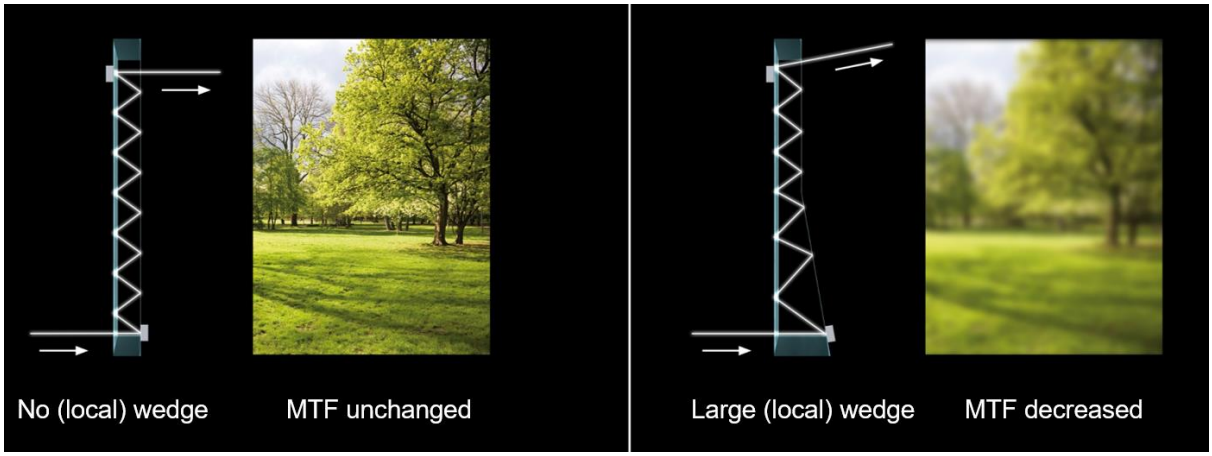

Figure 1: The (local) wedge directly impacts imaging quality. The effect is intensified by stacking of multiple (local) wedges in multilayer designs.

Wafer flatness is also a key factor in preventing distortion when miniature optics are fabricated using lithography-based processes. Because the light beams used for fabrication have a limited depth of field, wafers that are not perfectly flat will produce aberrations. SCHOTT's ultra-flat wafers ensure that a sharp lithography image is formed, reducing the need for corrections during fabrication and increasing yield.

3. A wide range of wafer materials

SCHOTT offers a wide variety of wafer materials with the flatness required for precise lithography on a wafer substrate. These wafers also feature tight geometric tolerances, which help produce optics that are efficient and reliable, even when used in challenging environments. Wafers made of optical and technical glasses as well as a multitude of other materials is available.

Technical glasses are cast as large sheets directly from the melting tank. These glasses are often selected because of their coefficient of thermal expansion (CTE), which can be matched to silicon. They are also very robust and can be manufactured cost effectively. If the total thickness variation (TTV) requirement is in the low microns, the glass can be cut to size and delivered as is. Polishing can be used to achieve lower TTVs. SCHOTT's technical glasses such as BF33, D263 and AF32 have been standard in the nanoimprint lithography for many years. More recently, we have unlocked a new level of precision by offering technical glasses with a high geometry grade. These new glasses combine a lower refractive index with high precision and high TTV.

Optical glasses are made by hot forming glass that comes directly from the tank. This glass is typically cut to pieces and delivered as a strip that is then processed with a chemo-mechanical polishing process down to tenths of microns TTV. Optical glasses are typically selected when there is a need for a high refractive index or Abbe number. They also exhibit excellent transmission in the visible range. SCHOTT has more than 120 optical glasses and five types of ultra-thin glasses. We offer optical glasses with refractive indices up to 1.9 or sometimes even higher.

SCHOTT also makes filter glass, which are useful for spectrum filtering and can be combined with an optical interference coating for even more functionality. Glass-ceramics like ZERODUR® are ideal for applications where a near-zero CTE and high thermal shock resistance are important. We also offer high geometry grade wafers out of sapphire and fused silica, both of which are important materials in the industry.

4. From melting to shipping

SCHOTT applies its expertise and experience to the entire process chain from the melting of optical glass, casting to strips, and various processes such as fine annealing and core drilling to the sawing, grinding, and polishing required to create a wafer. Our wafers undergo thorough quality inspection before delivery from the clean room and are produced according to SEMI standards, including dimensional, flat and notch specifications. Laser marking and a wide range of sophisticated coatings are also available.

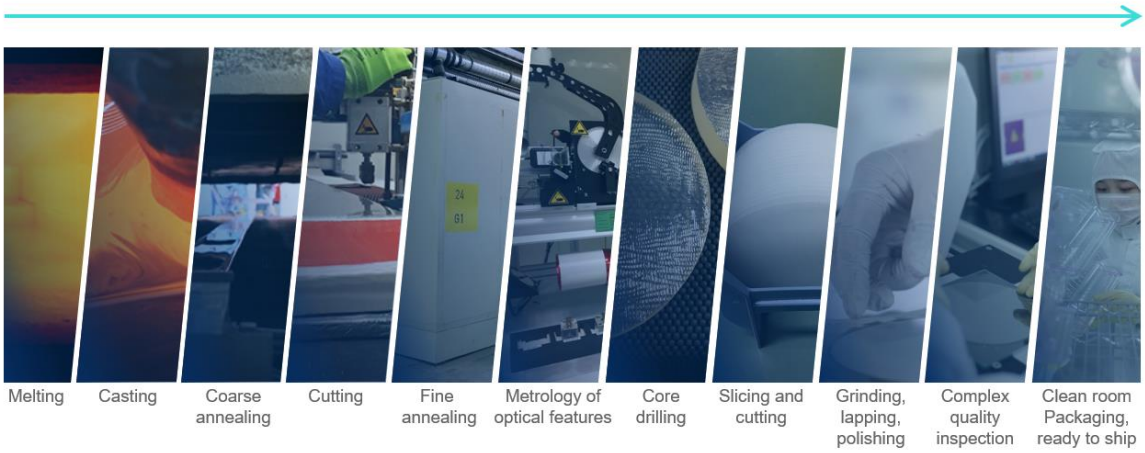

Figure 2: SCHOTT masters the complete value chain from glass melting to wafer fabrication.

Our knowledgeable R&D center can provide support for a variety of applications, and we also offer fast prototyping. SCHOTT's manufacturing facilities around the globe provide mass production on a consumer electronic scale while guaranteeing high quality. Quality reports are available for each shipment, and wafers can be packaged in wafer, cassette, or front-opening shipping box.

Want to learn more about optical wafers?

You can also visit our website for more information: www.schott.com/products/optical-components.

If you have any questions or need project support, feel free to contact us: info.optics@schott.com.

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