OmniCure®
UV Curing • In Control

Semiconductor Wafer Adhesion Reduction

The Challenge

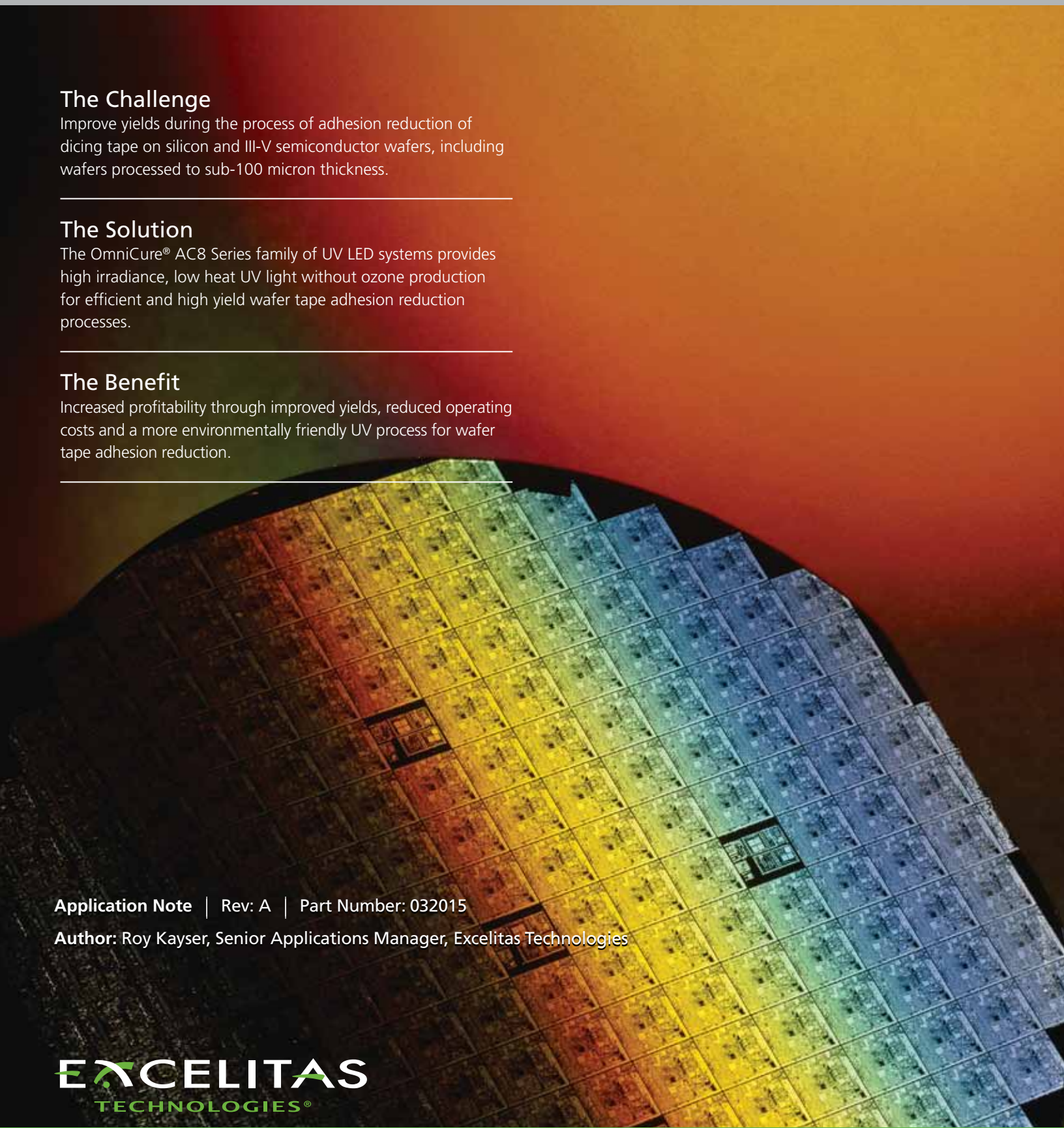
Improve yields during the process of adhesion reduction of dicing tape on silicon and III-V semiconductor wafers, including wafers processed to sub-100 micron thickness.

The Solution

The OmniCure® AC8 Series family of UV LED systems provides high irradiance, low heat UV light without ozone production for efficient and high yield wafer tape adhesion reduction processes.

The Benefit

Increased profitability through improved yields, reduced operating costs and a more environmentally friendly UV process for wafer tape adhesion reduction.



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Application Overview

Many semiconductor wafer processing techniques involve the fixing of a thin layer of dicing tape to a wafer during the final stages of processing. Using a pressure-sensitive adhesive, dicing tape holds individual die in place as the wafer is scribed or cut. However, the adhesion properties of the tape must be reduced to allow for removal of the die from the tape and tape frame. The adhesion of the tape is reduced with chemical solvents or more commonly with high-intensity UV light that degrades the adhesive qualities of the tape.

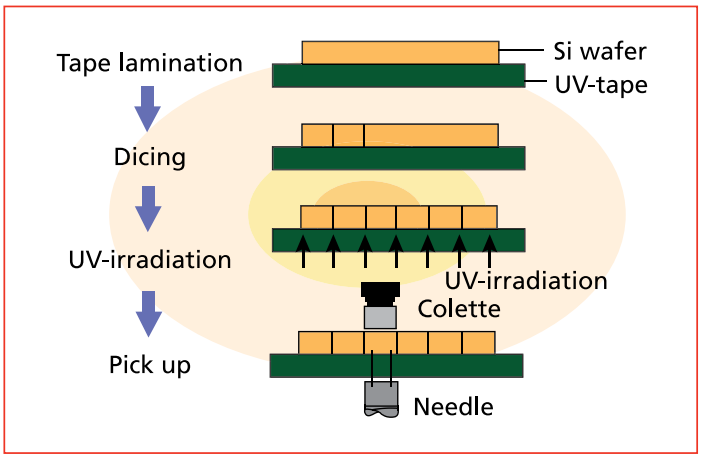

FIGURE 1: Schematic of a fiber optic drawing tower

In many manufacturing settings, UV light for the adhesion reduction process is produced by UV arc lamp systems. However, arc lamps introduce challenges to the process such as high electrical and maintenance costs, as well as overheating of sensitive parts. In contrast to arc lamp systems, UV LED systems deliver light from efficient, high output light emitting diodes and employ front-end optics designed to optimize the delivery of light, and to match the geometry of the processing site.

Because of their high reliability and low overall cost of operation, UV LED systems are already widely deployed in curing UV sensitive adhesives in manufacturing processes in the microelectronics, optics, and medical device industries.

These systems offer ozone-free production using high intensity UV light from long life UV LED optical heads that provide a wide range of beam sizes and configurations. The advantages that LED systems bring to curing of UV materials can also be realized in the reduction of adhesion in UV sensitive materials. This application note describes the advantages of using UV LED solutions as an alternative to arc lamps for removal of dicing tape.

UV LED Curing Systems for Wafer Tape Adhesion Reduction

Arc lamps systems have sufficient UV intensity for processing wafer tape, however, they require significant electrical power during operation due to their lower overall useful optical efficiency as compared to a solid state light source. UV arc lamp systems produce light over a broad range of the ultraviolet, visible and IR spectrums. While this provides very good compatibility with tapes, wavelengths outside of those useful in the reduction of adhesion, especially IR energy, are absorbed by the wafers and generate unwanted heat. This consequently reduces the yields of the tape adhesion reduction process.

In contrast to arc lamp systems, UV LEDs produce a very narrow spectrum of light centered at specific wavelengths - 365nm, 395nm and 400nm being most common. While compatibility with the dicing tape will depend upon the specific formulation, many tapes have chemistries that react well with the 365nm light produced by UV LED systems, and tapes are being optimized specifically for use with this technology. UV LED systems are compatible with silicon and SOI wafers and III-V wafers such as GaAs and InP. Because they are nearly monochromatic, UV LED systems induce very little heat into the wafer site, and are well-suited for use with delicate semiconductor devices such as QFN, microspeakers, and MEMS, as well as devices fabricated from brittle GaN wafers or even wafers processed to a thickness of less than 100 µm.

UV LED systems have also advanced significantly to now provide sufficient intensity for efficient tape adhesion reduction. Systems such as the OmniCure® AC8 Series have proven to produce a uniform output intensity of up to 4W/cm^2 at 365 nm, an appropriate UV irradiance to expose the adhesive layer of many types of dicing tape.

The OmniCure AC Series air-cooled UV LED systems offer a variety of configurations to accommodate different wafer diameters. The AC8 Series can support diameters of 150mm to 450mm, and features custom optics that optimize the delivery of light at different working distances. The OmniCure AC450 and AC475 systems provide an equally robust performance but in a smaller form factor to support smaller wafer sizes.

FIGURE 2: The OmniCure AC8300 curing system

UV arc lamps must also be replaced approximately every 2,000 to 8,000 hours, and replacement involves additional costs and production downtime. Moreover, many UV arc lamp power supplies (ballasts) are known to have lower reliability than equivalent UV LED power supplies. In contrast, UV LED systems can last well over 20,000 hours and are turned on and off nearly instantly, with no warm up times or simmer modes accumulating hours while no parts are being produced.

The broad spectrum of light produced by arc lamps includes light below 240nm, which generates ozone from oxygen in the air. This dangerous and reactive gas must be removed with expensive and complex venting and scrubbing equipment. This adds significant costs and makes it more challenging to qualify for stringent environmental standards such as EN 14001. Ozone will also be created when the deep UVC energy reaches oxygen trapped between the wafer and the tape. Ozone has a UV blocking characteristic which can result in incomplete wafer tape adhesion reduction.

The narrow spectrum of LEDs at 365nm, provides a wavelength suitable for many brands of dicing tape but with no ozone-generating deep UV light. With no UV-induced ozone, complex and expensive venting systems are unnecessary, which leads to substantial cost savings on installations in new facilities, as well as ongoing savings on maintenance and utility costs in existing facilities. Improved yields can also be realized due to the lack of trapped ozone with the tape layer. Because of their compact size, UV LED systems are also easy to integrate into new processing stations and existing stations in which arc lamps systems must be replaced.

Benefits of UV LED Curing Systems

The OmniCure AC8 Series UV LED systems offer many benefits for wafer tape adhesion reduction of semiconductor wafer processing that lead to lower costs and downtime, as well as increased profitability. These benefits include:

- Improved product yields. The narrow spectrum of the LEDs centered at 365nm are absorbed by the tape and not the wafers for reduced heating and improved yields in the tape adhesion reduction process. There are lowered incidences of die damage during die removal due to elimination of trapped ozone within the tape layer.
- Reduced electrical costs. The inherent efficiency of UV LED systems result in reduced electricity costs of more than 30% depending on the application.
- Reduced installation costs. No venting or scrubbing of UV-induced ozone exhaust is required.
- Higher manufacturing up-time. UV LED systems have operational life times more than twice that of lamp-based systems, resulting in increased manufacturing up time.
- Simplified environmental qualification. Because it does not produce ozone, the OmniCure AC8 Series UV LED curing system simplifies qualification for the stringent EN 14001 standard for manufacturing facilities.
- Ease of installation. The OmniCure AC8 Series UV LED system can easily be installed in existing wafer processing stations and are compatible with existing manufacturing processes
- Ease of installation. The OmniCure AC7300 UV LED system can easily be installed in existing curing stations and operated with existing manufacturing processes.

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