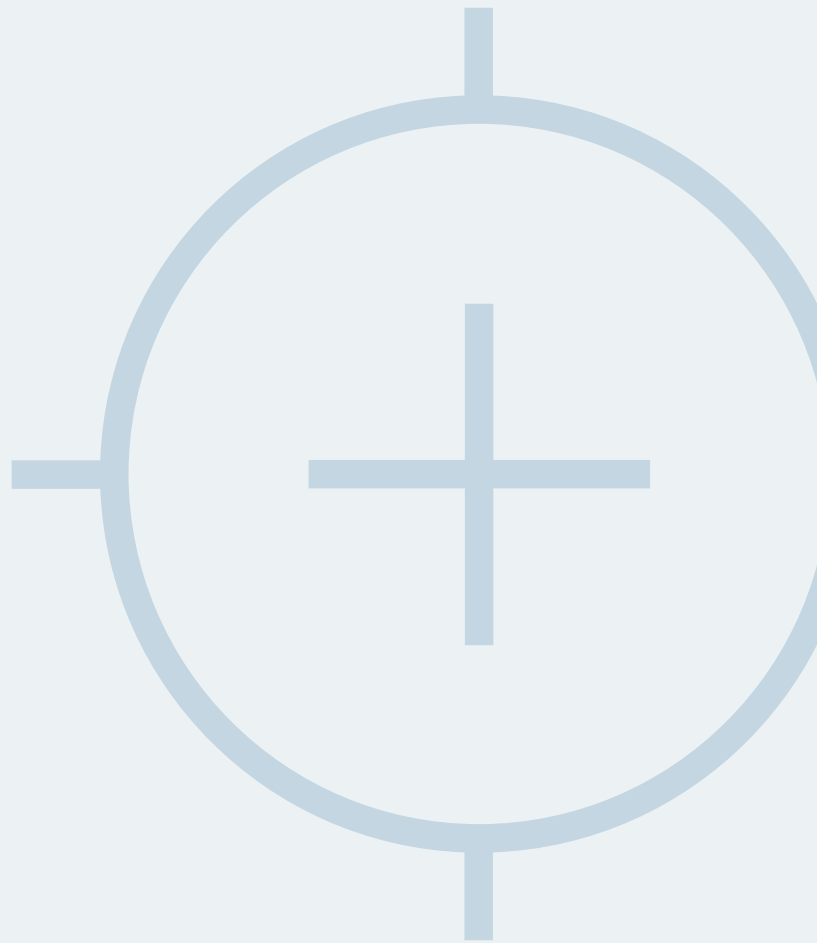


UV-LED LAMP HOUSE – LIGHT SOURCE OF THE FUTURE

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UV-LED LAMP HOUSE – LIGHT SOURCE OF THE FUTURE

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The new, innovative UV-LED lamp house concept of SUSS MicroTec combines high efficiency and flexibility with eco-friendliness and reduced complexity and represents a trend-setting alternative to common lamp houses.

It supports full process capability for today's lithography users and enables tomorrow's process technologies.

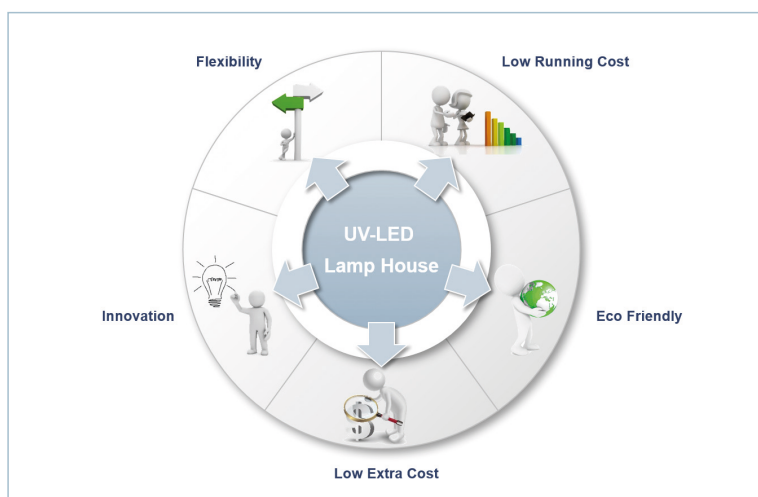


Figure 1 Key features of the UV-LED lamp house

One key element in semiconductor lithography is the exposure UV light.

The demand for an exposure with high intensity and good uniformity all over the substrate surface as well as the emission of a suitable spectral range are major challenges facing the development of light sources and defraction reducing optics for mask aligners.

Exposure of photosensitive resists requires very sophisticated light sources and only a few are suitable for this highly specialized task. Since many years the commonly used light source is a mercury short-arc lamp (Hg lamp). It provides the proper wave length ranges combined with high

intensity. It is well-proven and serves the market for exposure tools in the semiconductor industry.

On the other hand the use of these lamps is associated with multiple challenges and risks.

Limited life time, high maintenance intensity, use of harmful mercury and the high operating pressure of the lamp are only a few factors making the use of these lamps cost-intensive, ecologically sensitive and safety-at-work mandatory.

But what are alternatives?

In the past years the development of LEDs has made good progress and therefore it found its way into everyday life. LEDs are durable, versatile, "green" and economic. Also the development of UV-LEDs driven mainly by industrial applications has advanced recently.

So why not use in a lamp house?

SUSS MicroTec has made an important step into the future by developing a new UV-LED lamp house.

Technical Facts

The newly developed lamp house uses a state-of-the-art UV-LED light source including the latest technologies. The LED arrays provides a several wavelengths spectrum suitable for today's advanced processes and resists.

The additional flexibility enables new processes and easier operation and maintenance of the equipment.

The used UV-LEDs deliver a similar spectral range as common Hg lamps. They provide comparable intensity and uniformity for the main Hg spectral lines 365 nm (i-line), 405 nm (h-line) and 436 nm (g-line). The variability however is considerably

higher. The different wavelengths can be selected specifically and also adapted individually to a desired intensity. A combination to achieve a broadband illumination is also possible. Filtering of the exposure light by external filters is no longer necessary. The exposure spectrum can be tailored by software and stored for each process in the standard recipe file.

This new flexibility results in increased process stability and less maintenance work for calibration. Operation is easy to learn and operator induced errors (e.g. forgotten filters) are reduced.

Exposures by Fraunhofer Institute IZM, Berlin show that the use of an LED light source delivers similar resolution compared to a common Hg lamp. The prints have been made in combination with the highly specialized SUSS MO Exposure Optics to achieve optimum results.

In contrast to an Hg lamp the LEDs do not need a warm-up time until they are ready to use. After switching on they immediately emit the desired spectral range with the selected intensity.

You can now turn on the UV-LED light source only for the period of exposure. Thus the energy consumption of the UV-LED light source is significantly lower compared to the Hg lamp which has to run continuously to provide the desired process stability.

Further the inevitable Hg lamp shutter, opening the light path during exposure time is no longer necessary. Thus no time consuming maintenance for the shutter function is required.

LEDs have a long life time. In comparison to a mercury short-arc lamp it is many times higher. There is no longer a need for regular acquisition of the Hg lamps. Neither time extensive lamp exchange, nor multiple maintenance work is necessary any more. More than this the disposal of the light bulbs as special waste gets obsolete.

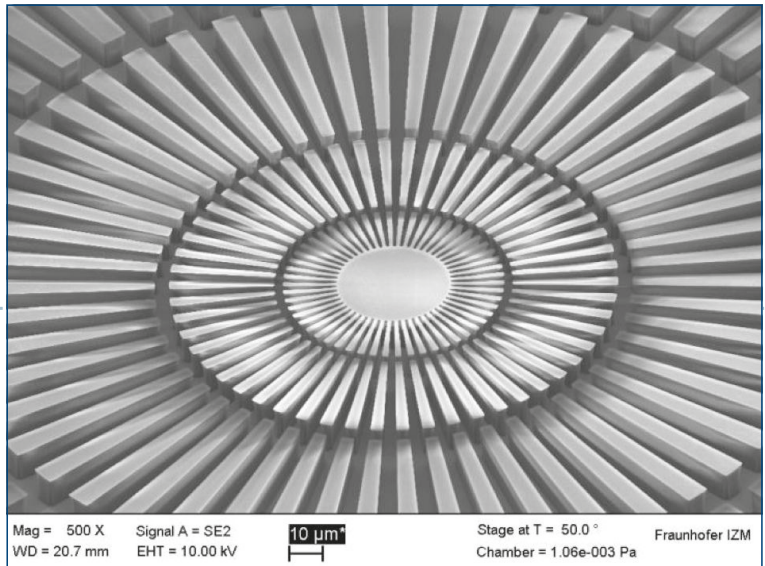


Figure 2 10 μm AZ9260, UV-LED g-line, hard contact *Courtesy of Fraunhofer IZM, Berlin*

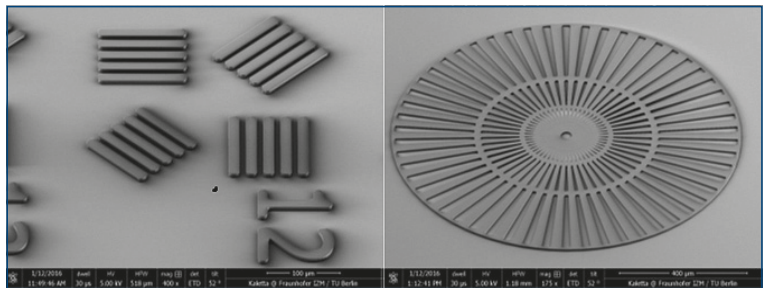


Figure 3 8 μm AZ2070nLOf, UV-LED 20 μm, proximity *Courtesy of Fraunhofer IZM, Berlin*

Safety and Environmental Compatibility

The use of today’s mercury short-arc lamps is extremely critical in terms of environmental compatibility and safety. The mercury used within these lamps is acutely poisonous and requires high standards for health management and accident prevention. Environmental friendly disposal is complicated and expensive.

During operation the Hg lamp becomes very hot and builds up high pressure. External cooling and its control are essential.

The use of an UV-LED light source renders all those critical items redundant. It is environmental compatible, works with low pressure and requires no maintenance work. Air cooling of LEDs is directly attached to the array.

No additional cost is necessary for an extensive disposal.

Especially concerning safety requirements the UV-LED lamp house offers tremendous advantages. Besides protection against UV light no special precautions are necessary for this kind of light source.

The UV-LED light source follows the world-wide need for eco-friendly and energy-saving behavior. It supports European initiatives to reduce use of hazardous material and high power consumption.

Cost-Of-Ownership

The low energy consumption and the long life time of the UV-LED light source combined with marginal maintenance and disposal costs create a positive cost-of-ownership balance for our customers.

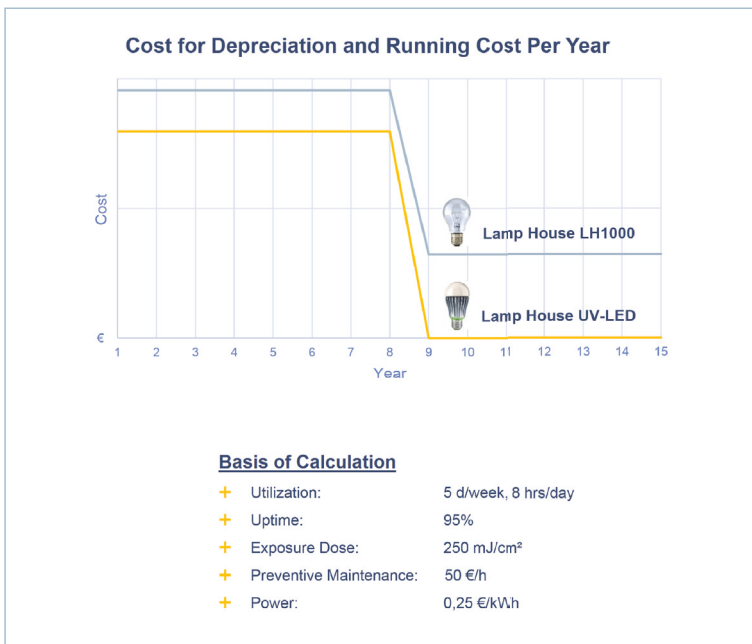
Slightly higher acquisitions cost is compensated by significantly lower running cost and the absence of service and maintenance times.

Figure 4 shows a typical cost-of-ownership balance of a classical Hg lamp house (blue) in comparison with the UV-LED light source (yellow).

After a depreciation time of 8 years the running cost for the UV-LED lamp house will decrease dramatically and will tend to zero while the use of an Hg lamp house will produce yearly cost of at least 2.500€ for power consumption, lamp exchange and maintenance.

The UV-LED lamp house is currently available for manual Mask Aligners SUSS MA/BA8 Gen3 and SUSS MA/BA6 Gen3. It is combined with the highly specialized SUSS MO Exposure Optics for optimum uniformity and resolution results.

More products are planned to be equipped with the UV-LED lamp house in the future.



Bettina Kothe studied Photo Engineering in Köln with a specialization in Physical Optics. 1982 she started at Karl Süß KG as a research engineer. She was project engineer for Automatic Alignment and for the development of the first manual Mask Aligner MA6. For some years she joined the Marketing Department as Product Manager Mask Aligner. Since 2000 she is responsible for Technical Documentation at SUSS MicroTec Lithography GmbH, Garching.

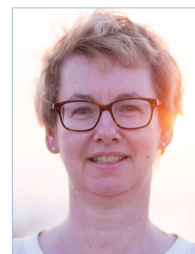


Figure 4 Comparison of cost between Hg lamp house and UV-LED lamp house