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THE
DIFFERENCE

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HOW THE LATEST REFLECTOR TECHNOLOGIES ARE ENSURING A BRIGHTER FUTURE FOR UV EQUIPMENT

Innovative reflector technologies offer higher performance and a longer lifespan for ultraviolet equipment, says Dr. Ziegler, Head of Research & Development at Alanod.

Invisible to the human eye, ultraviolet (UV) light plays a critical role in a host of industrial and medical applications. UV light sources are used to cure inks, lacquers and resins in printing and additive manufacturing equipment. They power phototherapeutic devices and tanning beds. And they provide a flexible, reliable and chemical-free way to disinfect water, air and surfaces, or to sterilise medical devices, food and liquids.

The majority of UV applications rely on efficient reflectors to direct the light and to maximise the probability of UV photons interacting with their target. Many materials that are highly efficient reflectors of visible light perform poorly at UV wavelengths, however. Polished stainless steel, for example, reflects only around a quarter of incident UV-C radiation.

Fortunately, there is a material that offers much higher reflectivity at UV wavelengths, while also being robust, cost-effective and easy to fabricate. That material is aluminium.

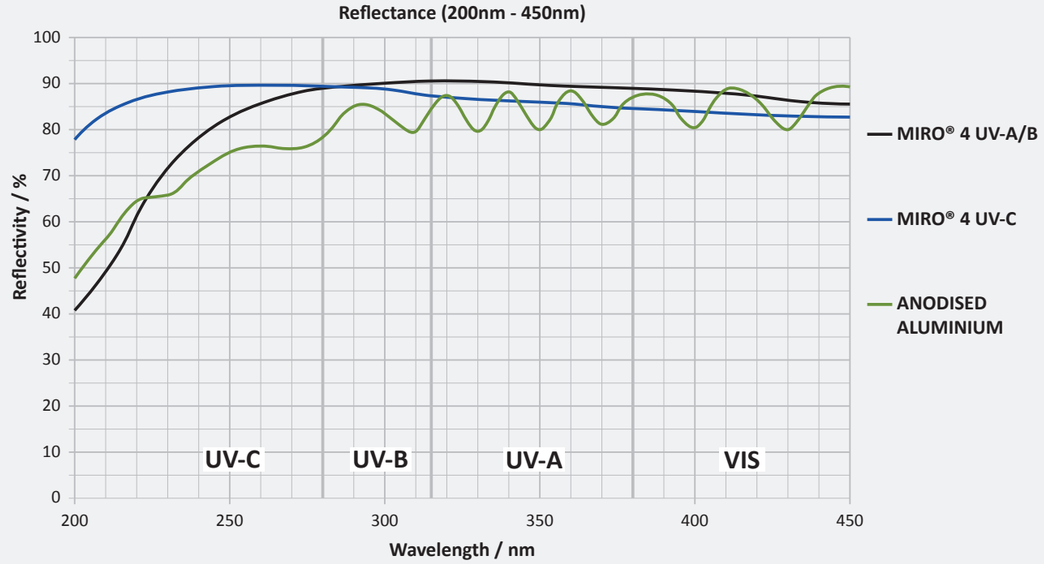


Fig.1 - The UV reflectivity of anodised aluminium can vary by as much as 10%

A conventional anodised aluminium surface will reflect more than 80 percent of incident light at UV wavelengths. That's a three-fold improvement over stainless steel, but our surface innovation engineers at Alanod have found a way to do even better.

The key to our approach is a technology that turns a limitation of standard aluminium reflectors into a strength. As the graph in figure 1 shows, the UV reflectivity of anodised aluminium varies by as much as 10 percent depending on the exact wavelength of the incident light. That phenomenon is the result of interference effects. When UV light hits an anodised surface, part of the light is reflected from the material's oxide layer and part is reflected from the pure aluminium beneath the anodised surface. Those two reflections interact, effectively boosting reflectivity at some wavelengths and reducing it at others.

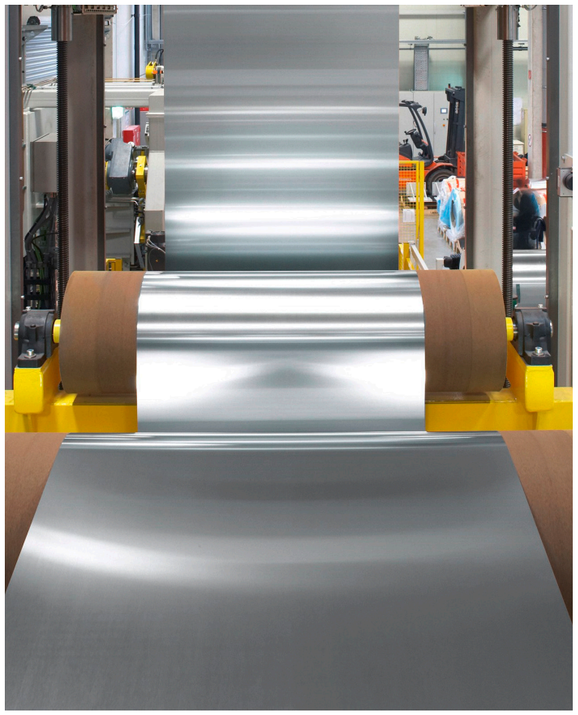
Using conventional surface treatment techniques this interference effect is impossible to control. The oxide layer on an anodised surface will vary in thickness, and it will grow over time as the material reacts with oxygen in the environment.

Nanoscale surface technology

To create a new generation of UV-reflective materials, Alanod needed to find a new way to add a protective surface to pure aluminium. Our scientists needed a technology that would allow us extremely precise control of the surface layer, so we could control the interference effects and boost reflectivity where it would be most useful.

The approach we have adopted is plasma-enhanced chemical vapour deposition (PECVD). This technique uses an energetic plasma to deposit material onto a surface at lower temperatures than conventional physical vapor deposition methods. For Alanod's new MIRO® UV products, the material deposited is a precisely controlled silicon oxide layer around 100nm thick.

Because the new process gives us much greater control over the thickness of the surface layer, it lets us tune the performance of our materials to specific UV wavelengths. MIRO® UV A/B offers UV reflectivity of more than 90 percent at wavelengths of 300 to 350nm, while MIRO® UV C is designed to deliver a peak of well over 90 percent at the 250nm wavelength used most commonly in UVC applications such as disinfection and sterilization equipment.



Double the durability

PECVD technology offers another major advantage for the production of UV-reflective materials: greatly enhanced durability. Intense UV light creates demanding conditions for surface coatings, generating large numbers of charged particles that can greatly accelerate normal oxidation processes. Conventional anodised materials are highly durable in most applications because their surfaces exhibit "self-limiting" properties.

The layer of aluminium oxide on the surface initially grows, but eventually stabilises as the remaining exposed pure aluminium is converted to oxide. In UV equipment, however, oxidation continues through the life of the equipment; eventually requiring components to be replaced as their reflectivity falls.

The silicon surface of MIRO® UV materials, by contrast, has extremely low porosity, creating an effective barrier against oxygen ions. In intensive tests in a high temperature, high humidity environment, MIRO® UV exhibited a change in reflectivity of less than 1 percent after 1000 hours.

In the absence of methods for the accelerated testing of UV reflective materials, we can't predict exactly how long our products will last, but we are confident of a lifetime at least twice that of conventional aluminium reflectors.

Engineered for versatility

Below the innovative surface coating the MIRO® UV material range includes other layers of innovative engineering, designed to increase performance, durability and ease of use for manufacturers.

The substrate consists of a thin layer of 99.99% pure aluminium, for maximum reflectivity, bonded to an aluminium alloy body material that provides additional strength for easy handling during manufacture. The substrate can be delivered with a range of different surface finishes.

A polished surface may be the best choice for applications requiring precise control of the angle of reflection, for example, while greater surface roughness can improve the distribution of reflected light in sterilising equipment and similar applications.

CREATE THE DIFFERENCE

Ultraviolet light is powerful and flexible tool in a host of industrial, business and medical applications. Many of those applications are experiencing rapid growth.

UV disinfection technologies, for example, are playing a key role in the response to the coronavirus pandemic, as healthcare providers institutions and individuals seek safe effective ways to reduce the risk of virus transmission.

With its new MIRO® UV product range, Alanod provides UV technology companies with simple and effective a way to boost the performance, reliability and longevity of their equipment.

For more information about UV solutions or for technical advice, please visit www.alanod.com

Alanod GmbH & Co. KG
Egerstraße 12
DE - 58256 Ennepetal

T: +49 2333 986 500
M: info@alanod.de
W: alanod.com

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