surrey nanosystems

V2 May 2020

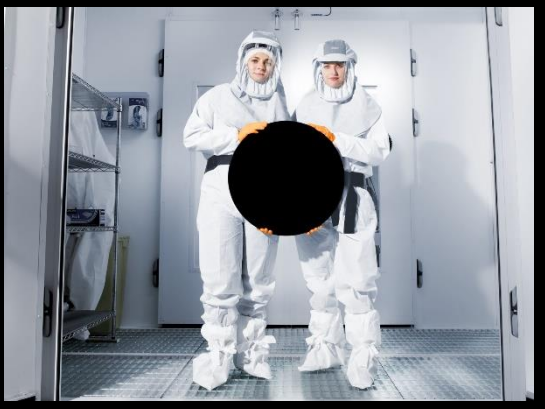
Introduction to Vantablack® Absorber Coatings Used In Automotive Stray Light Suppression

VANTABLACK

Where Vision Makes the Difference

Surrey NanoSystems Background

- Established 2007, East Sussex, UK
- Venture Capital backed, with access to strong financial resources
- Patented technology in sprayed super-black coatings
- Launched Vantablack® branded range of super-black coatings 2016, first HUD and LiDAR integration in 2018
- Rapid expansion, with new Production facilities providing Coating-as-a-Service (CaaS) to Automotive sector
- R&D Facility for training and product development
- Strong scientific team: PhDs, MChem and MPhys qualified research scientists to help address customer challenges



US Representative:

Santa Barbara Infrared, Inc.
Suit D
30 S. Calle Cesar Chavez,
Santa Barbara, CA. 93103

UK R&D centre:

Building 24,
Euro Business Park
Newhaven, East Sussex
BN9 0DQ

UK Production:

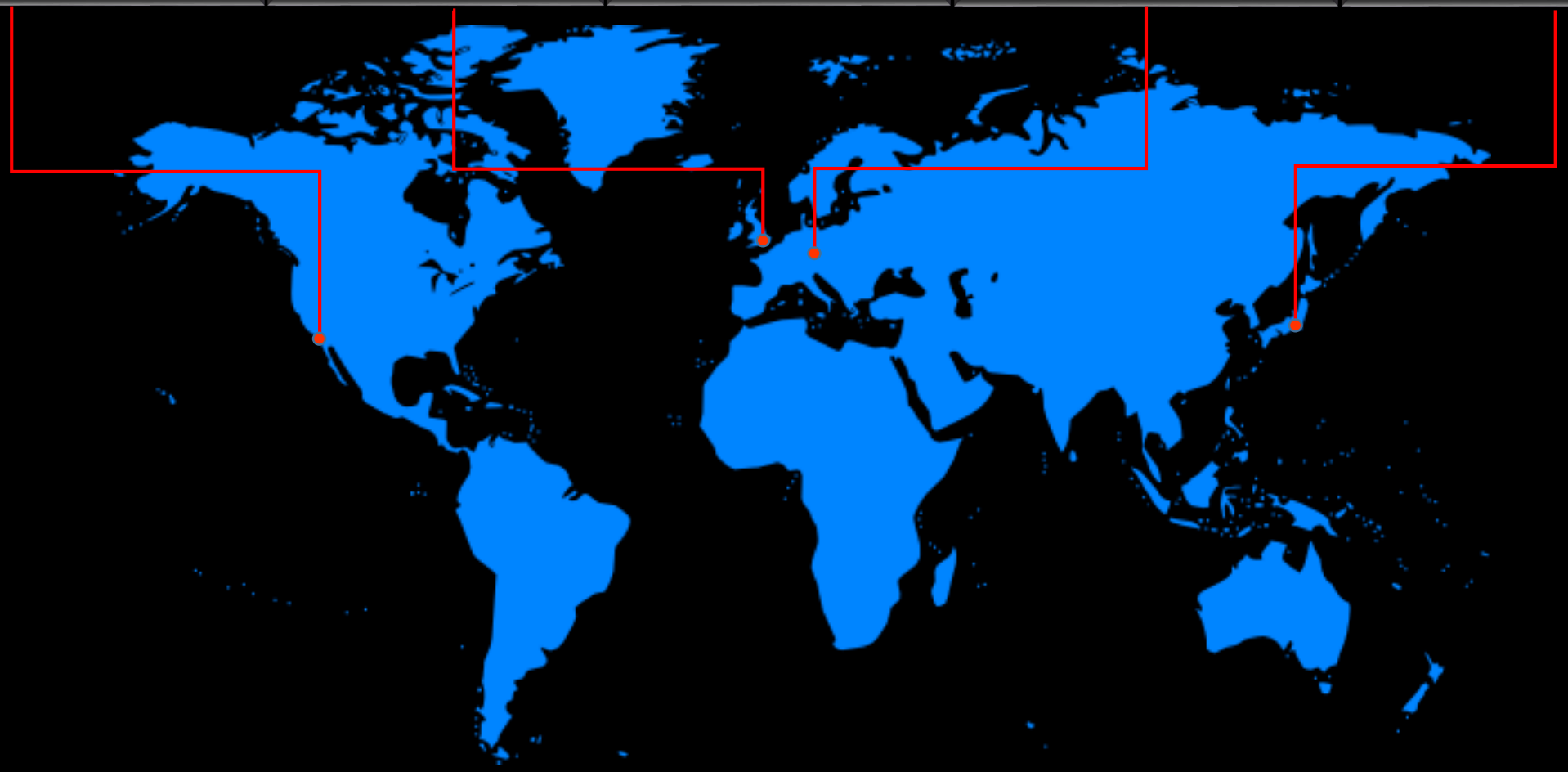
East Side Business Park
Beach Road, Newhaven
East Sussex
BN9 0FB

Germany Sales Office:

Automotive Coatings
Frankfurt, Germany
+ +49 151 22919105

Japan Representative:

Ocean Photonics, Inc.
Nishi Waseda 3-30-16,
Shinjuku-ku,
Tokyo 169-0051



surrey nanosystems

UK Facilities and Global Representatives

Surrey NanoSystems Automotive Coatings Business Model

Coating as a Service

- Customer parts are shipped to our UK production facility for coating to customer specification.
- Sourcing of substrates and assembly of coated parts can also augment basic coating processes
- We can provide assistance on logistics to ensure shipping and import/export controls are managed effectively

Technology Transfer

- Applies to Vantablack S-VIS.
- Where volumes are high then it is possible to licence the technology for use in your production facility.

VBx2 Bulk Supply

- VBx2 is a paint like coating that that customers are able to purchase in bulk for application in their facilities.
- The coating uses conventional spray gun technology so capital investment is low.
- Spraying VBx2 is different to applying conventional paints so specialist technical training is available

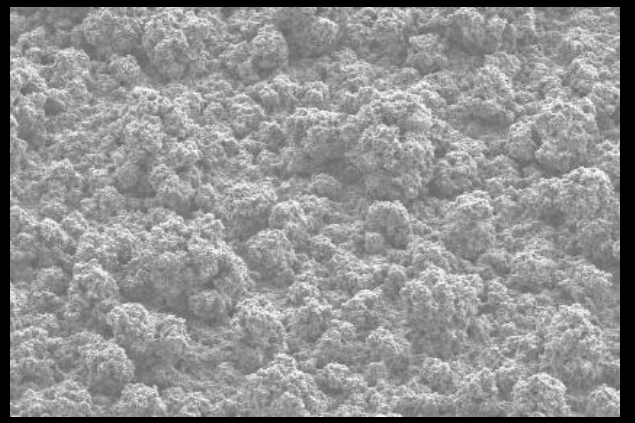
Automotive Coating Range

- S-VIS: HUD Systems, Exterior Lighting and LiDAR
- VBx2: Camera Shields, Exterior Lighting and HUD systems

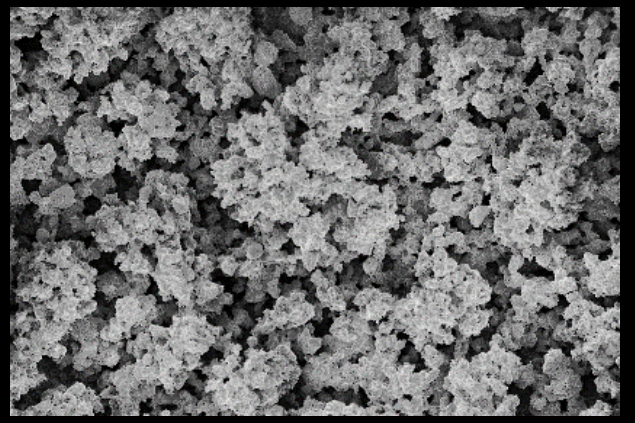
Unique, complementary, super-black coatings for automotive applications

- Vantablack S-VIS – spray-applied wide area coating, exceptional performance across the spectrum from ultraviolet to far infrared – used for critical stray light control (coated parts require vacuum post spray processing so maximum part size is 650mm x 450mm x 150mm)
  - Head Up Displays
  - LiDAR
  - Exterior Lighting
  - THR (Total hemispherical Reflectance) – 0.2%

- Vantablack VBx2 – Conventional spray application, no scale limitations, used for stray light control in automotive camera shielding, exterior lighting systems , architecture and aesthetic applications
  - Camera Shields
  - Head Up Displays
  - Exterior Lighting
  - THR (Total hemispherical Reflectance) – 1%



Vantablack S-VIS



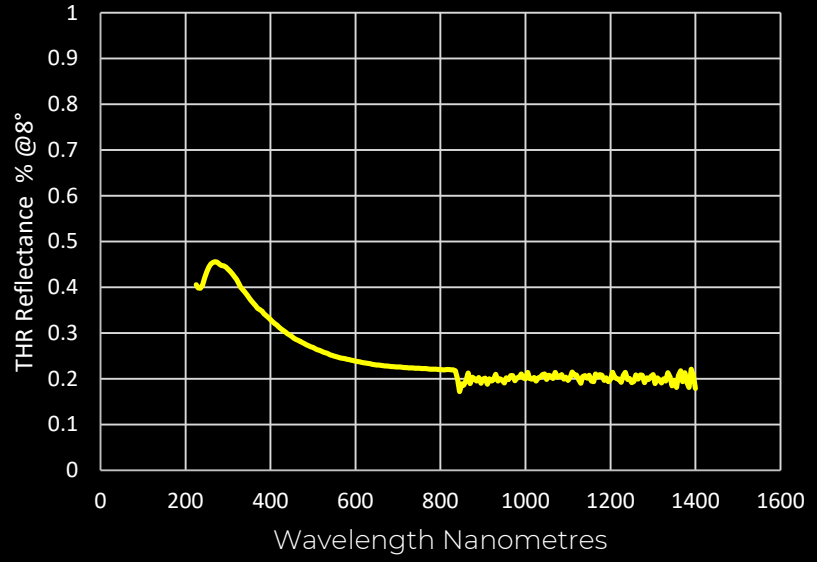
Vantablack VBx2

SEM Micrograph Images

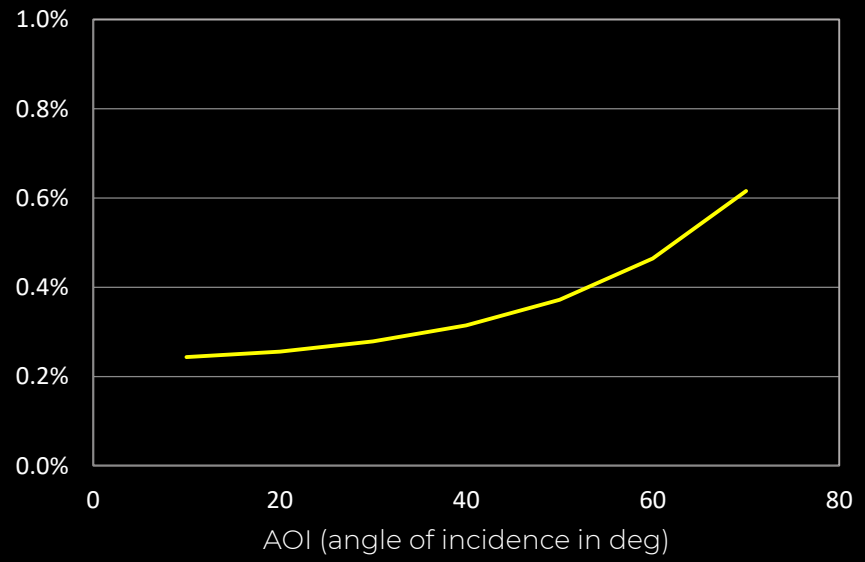
Not Just Another Black Coating

- Vantablack S-VIS provides exceptional performance in ADAS applications because of it's very high level of absorption. Uniquely, and unlike other paints and flocks, it retains this performance from almost all viewing angles
- This means light hitting the absorber surface from any angle is efficiently captured and unable to interfere with critical elements within the electro optical assembly
    - This is not the case with conventional paints and flocks where sunlight frequently blinds the sensor or produces significant artefacts through sparkling or high levels of reflectance

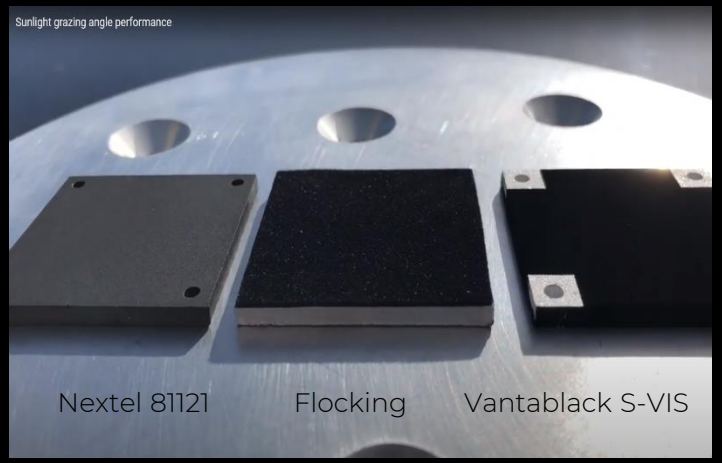
Vantablack S-VIS: Absorption



Change in absorption vs AOI - 400nm – 800nm

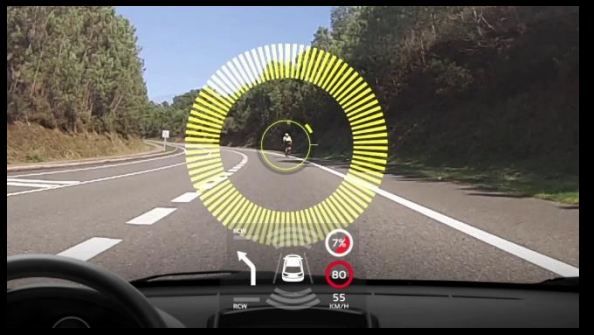


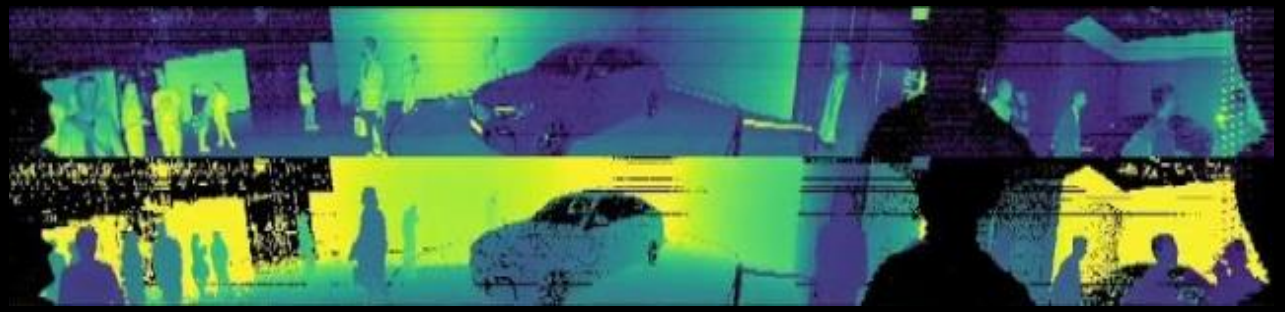
Sunlight grazing angle performance
Video clip at:
https://youtu.be/EBF8LbytHZc



Improving Driver Safety In Automotive Applications

- Head Up Displays
- Camera Glare Shields
- Headlamps
- Tail Lights
- LiDAR Sensors



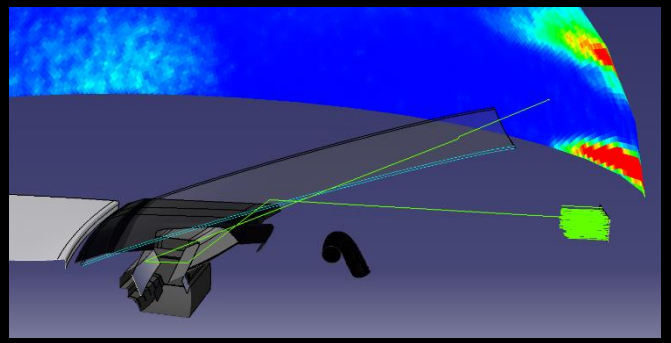


Head Up Displays

- Significant improvement in window ghosting artefacts
- Improved contrast ratio for next generation optics
- Removal of complex baffle foam and flocking processes
- Solves adhesion issues found with conventional paints on certain substrate types

Existing coatings allow distracting sunlight artefacts in the drivers line of sight

Vantablack coated HUDs deliver artefact free performance in all lighting conditions



Model simulating sunlight interactions in the HUD © ANSYS OPTIS

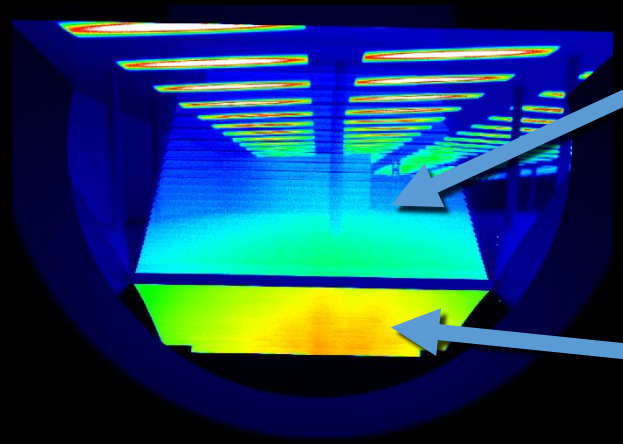
Conventional black coating simulation shows significant screen artefacts in the drivers line of sight

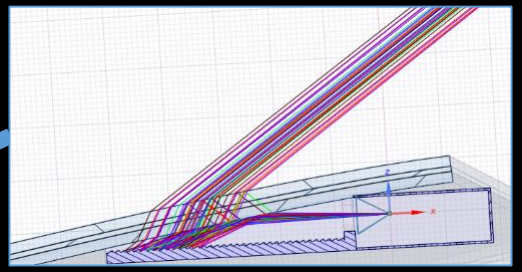
Artefacts now eliminated using Vantablack S-VIS © ANSYS OPTIS

Data Courtesy of ANSYS OPTIS https://marketing.optis-world.com/acton/fs/blocks/showLandingPage/a/17674/p/p-012a/t/page/fm/0

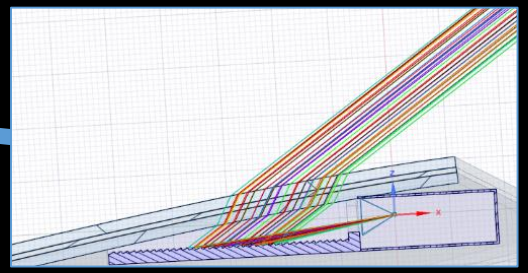
ADAS Camera Glare Shields

- Ghosting and overexposure can be virtually eliminated
- Veiling glare drastically reduced
- Baffle structures can be eliminated, simplifying manufacturing processes
- High contrast sunlight or night driving glare reduction



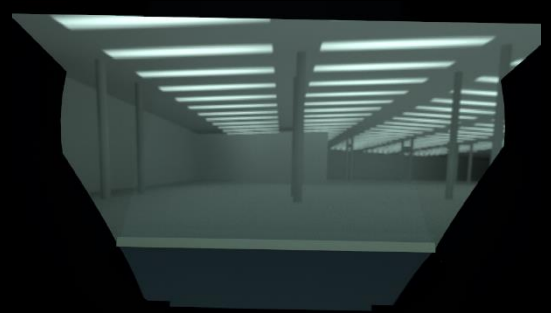


Reflection on the windshield



Direct sun reflection on prisms

Standard Automotive black paint



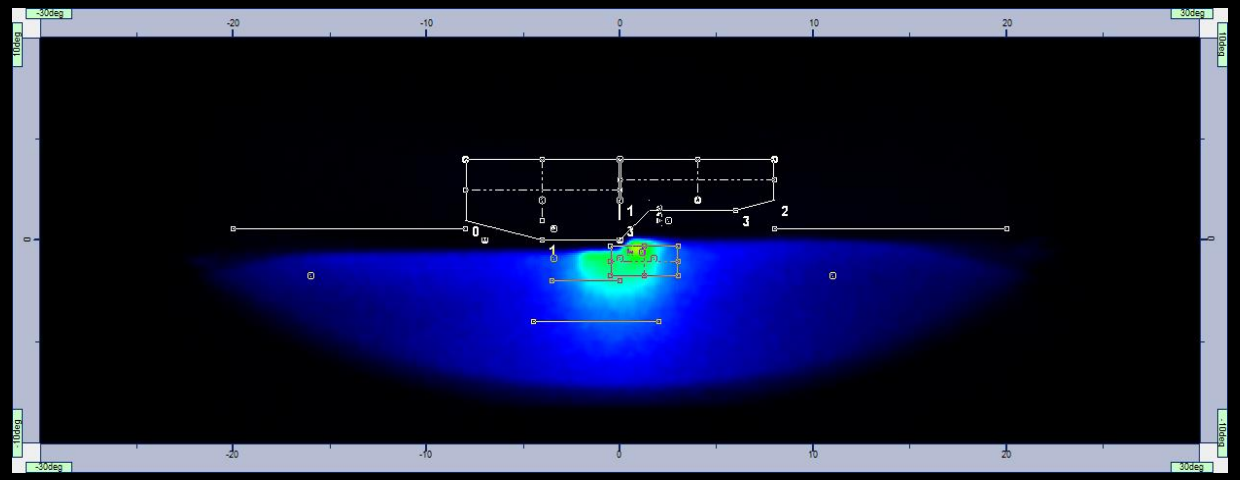
Vantablack S-VIS coated glare shield

Simulated results with Ansys SPEOS Light Expert

Headlamps and Tail Lights

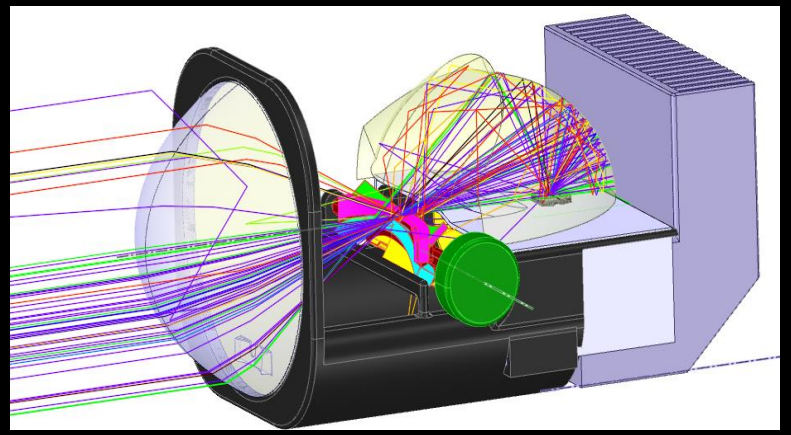
- Clean light cut-off line, minimal residual reflection
- Headlight glare reduction
- Precise Adaptive Driving Beam
- High definition road projection
- Meeting standards and regulatory requirements
- Innovative designs and unique visual effects possible

ECE R123 AFS LB C Regulation Light Intensity Template



Vantablack S-VIS brings the non conforming beam pattern back to EU legal limits without a major redesign of the beam optics

2020 Koenigsegg Jesko Absolute with Vantablack Headlights

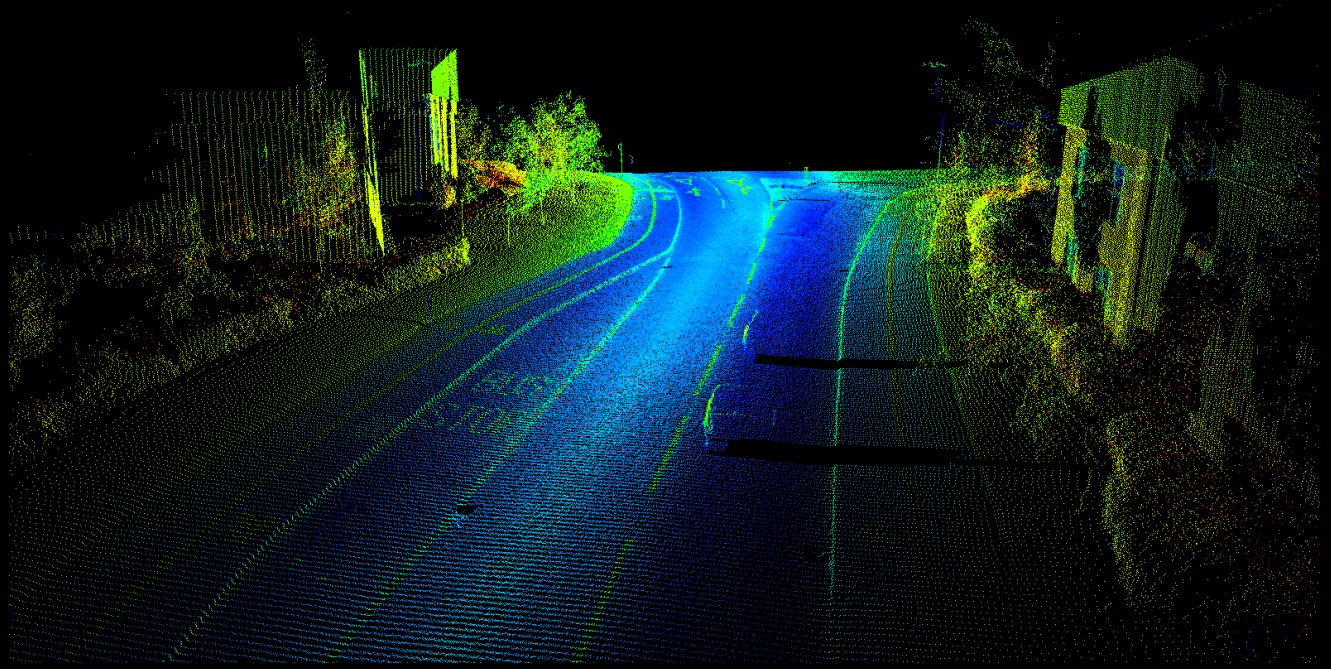


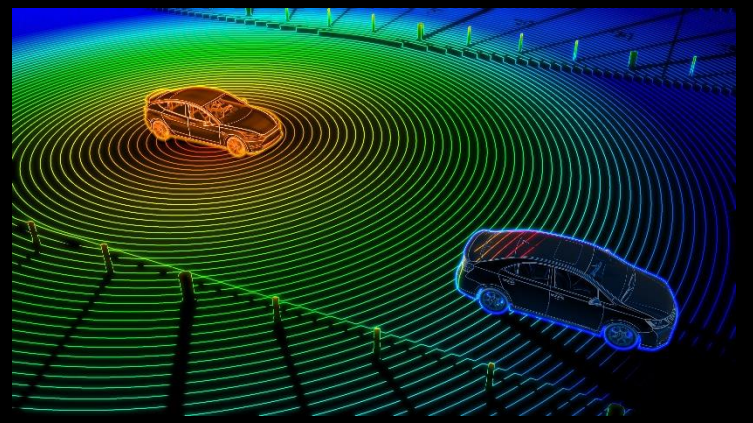
Ansys beam path simulation confirming expected performance benefit

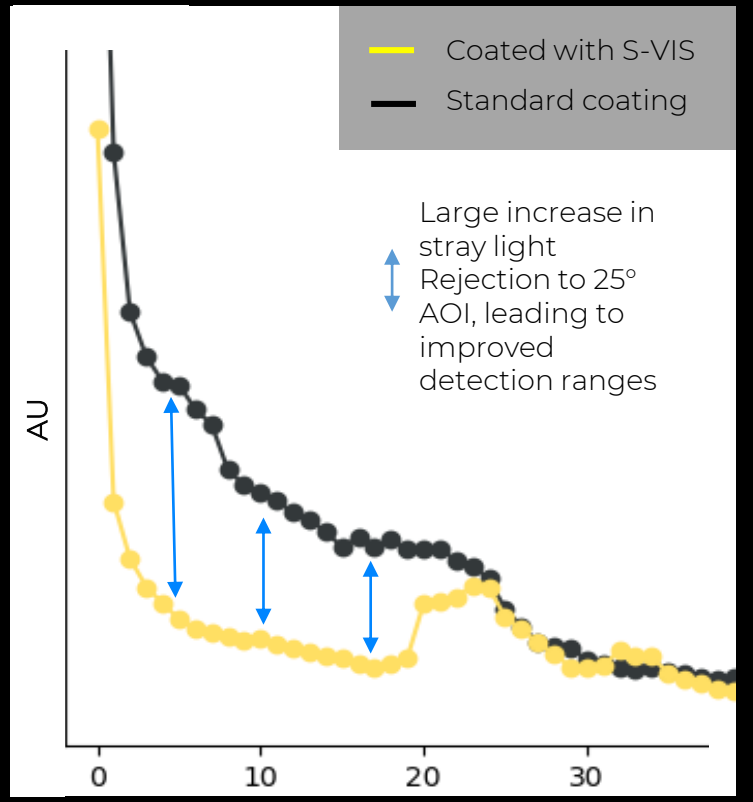
Simulated results with Ansys SPEOS Light Expert

LiDAR

- Improved straylight suppression over a wide field of view with the Vantablack coated detector housing
- This results in improved LiDAR performance under difficult, high contrast daylight and night driving conditions
- Higher S/N ratio leads to increased detection range and better recognition of low reflective objects







Data courtesy Blickfeld GmbH

Conclusion

- Vantablack® coatings improve driver safety by resolving stray light issues in automotive electro-optical sensors and systems
- Are scalable and well-suited to commonly-used automotive substrates
- They exceed thermal and mechanical requirements in-service
- They do not generate fogging residues
- They are not prone to UV degradation
- Vantablack coatings are scalable
- Both coatings are RoHS and Halogen compliant
- Performance demonstrated in real applications

surrey nanosystems

To discuss your application in more detail, or for more specific technical information please contact:

Michael Stellmacher

Global Market Development Director (Automotive)

Phone +49 151 22919105
m.stellmacher@surreynanosystems.com

www.surreynanosystems.com

VANTABLACK

Where Vision Makes the Difference