

# Vantablack Coatings For Space Applications

## Key Design Considerations

22<sup>nd</sup> April 2021

Steve Northam

Business Development Director

## Agenda

### What is Vantablack?

- Structure
- Benefits
- Space Heritage
- The application process

### Design Considerations

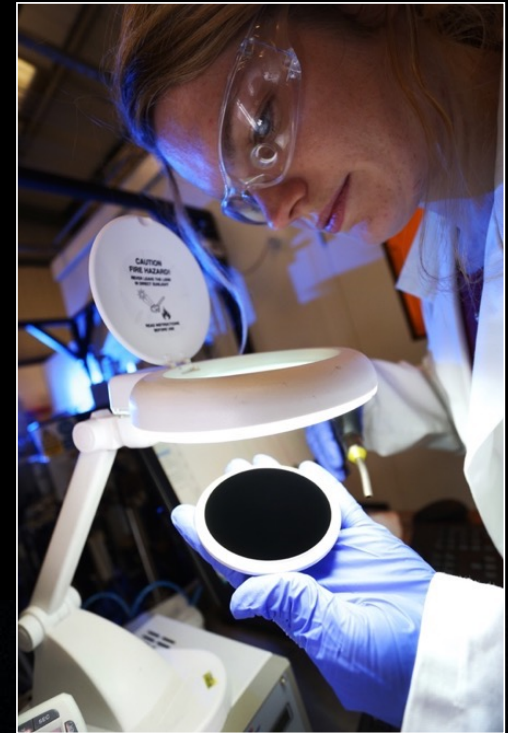
- Component Size & Form
- Substrate materials
- Handling
- Assembly operations

### Further Information

- Performance & qualification data
- Design guide
- Points of Contact

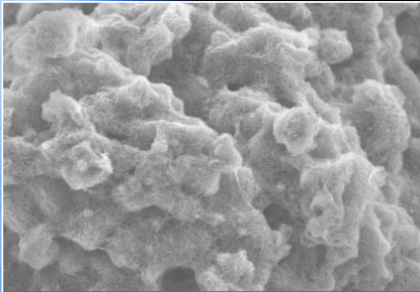
### Questions

VANTABLACK<sup>®</sup>  
LIGHT ABSORBING COATINGS



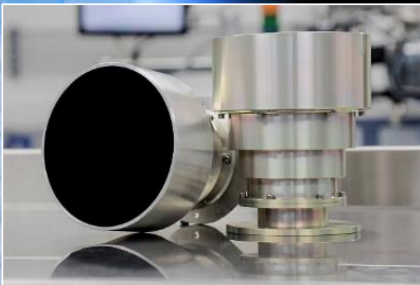
## What is Vantablack?

VANTABLACK<sup>®</sup>  
LIGHT ABSORBING COATINGS



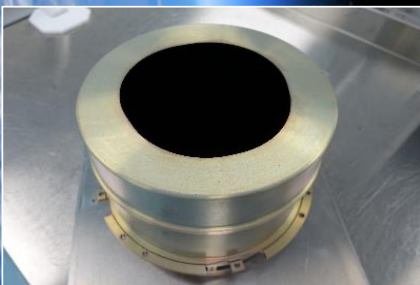
### Structure

- A very low density coating coral-like structure formed of independent carbon nanotubes
- **Vantablack S-VIS** - Recommended for 200nm to 6 $\mu$ m, also for 30 $\mu$ m to 100 $\mu$ m
- **Vantablack S-IR** - Recommended for 6 $\mu$ m to 30 $\mu$ m
- **Bonded coatings** –A CNT underlayer is ‘locked’ into a polyimide base – this maintains excellent adhesion on knife edges



### Benefits

- Improved stray light control in optical systems UV – FIR over wide AOI
- Can allow reduction in baffle weight, complexity and size whilst maintaining or improving performance
- Extremely high emissivity and spectrally flat from NIR to FIR can help simplify blackbody design reducing mass and cost



### Space Heritage

- 8+ years total on orbit time – inboard & external ram, wake and zenith locations
- Selected & qualified for large sat and small sat baffles and calibration blackbodies

## What is Vantablack?

VANTABLACK<sup>®</sup>  
LIGHT ABSORBING COATINGS

## Application Process for S-VIS/S-IR

### Preparation

- Tooling design & manufacture
- Masking is done using hard tooling or si free tape

### Spray deposition

- Polyimide base layer (if used) and Carbon Nanotubes are deposited by spraying either by hand or robot (line of sight)
- Masking is removed after spray deposition stages

### Post-processing (activation)

- Coatings are post-processed in SNS' own reactors to create required optical cavities and also to make the finished coating hydrophobic
- Reactor process steps take place under vacuum and up to 280°C

### Technology Transfer for on-site application

- SNS are open to Tech Transfer and Licensing subject to agreed business plan to support the considerable capital investment required



## Design Considerations

*Not a comprehensive guide – please consult with us for details*

### Component Size & Form

- Parts to be coated must fit within vacuum chamber envelope
- Maximum 650mm(X) 450mm(Y) and 125/230mm(Z) – larger chamber possible/investment
- Spray process is LoS – so "shadow" areas cannot be coated – design for access/assemble

### Tubes and holes

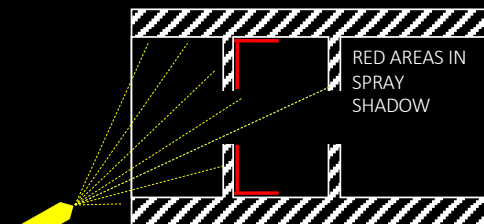
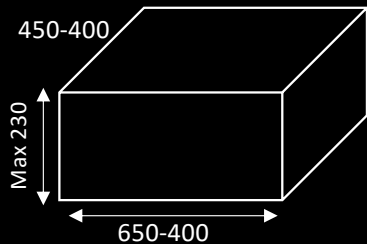
- For open ended tubes <c150mm length we aim to limit L/D to 2.5max – please consult us
- Blind tubes/cavities can be difficult due to fan gas turbulence – please consult us

### Knife edges

- Excellent coating of knife edges is possible with the polyimide bonded version of S-VIS/S-IR
- Coating should not be terminated at the edge
- Knife edge angle should be 30° or greater

### Threads & Grooves

- Functional threads should not be coated
- Grooves can be coated – though high aspect ratio grooves can be difficult
- Pooling or over-etching can occur



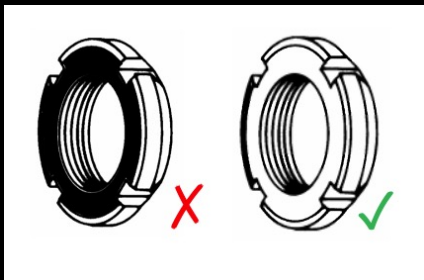
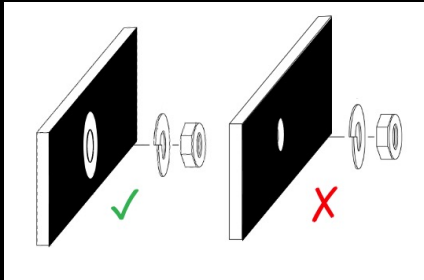
## Design Considerations

*Not a comprehensive guide – please consult with us for details*

VANTABLACK<sup>®</sup>  
LIGHT ABSORBING COATINGS

### Substrate Materials

- A wide range of substrate materials can be coated.
- Vantablack does not provide corrosion protection but coating can be applied to Alodine/Surtech treated surfaces
- Coating on anodised surfaces is OK, must be hot-water sealed
- Gold surfaces to be Vantablack coated must have a nickel underlayer
- As always – please contact us if unsure



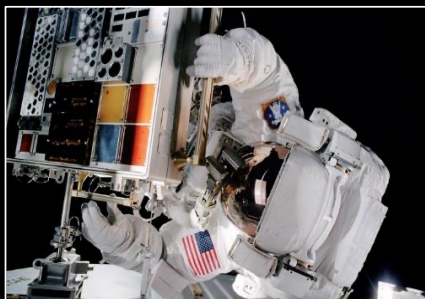
### Handling

- As the Vantablack surface cannot be touched, consideration must be given to how parts will be handled and packed for shipping
- Existing (or new) features to be designated as handling points
- Ensure screwheads/washers do not impact coated areas
- Any features for tool engagement should be clear of Vantablack coating

### Assembly Operations

- SNS is able to undertake simple assembly tasks after coating.
- This means that any coating damage occurring during assembly can be rapidly reworked.
- Packaging is also simplified and cheaper.





MISSE deployment Credit: NASA

## Further Information

[www.surreynanosystems.com](http://www.surreynanosystems.com)

Datasheets

Qualification data & space heritage

BRDF Data

Designers' guide

VANTABLACK<sup>®</sup>

LIGHT ABSORBING COATINGS

**Steve Northam - Business Development Director**

Tel: +44(0)7415 896 875

Email: [s.northam@surreynanosystems.com](mailto:s.northam@surreynanosystems.com)

**Ben Jensen – CTO**

Tel: +44(0)1273 515 899 ext 212

Email: [b.jensen@surreynanosystems.com](mailto:b.jensen@surreynanosystems.com)

