



Microstructures and Coatings

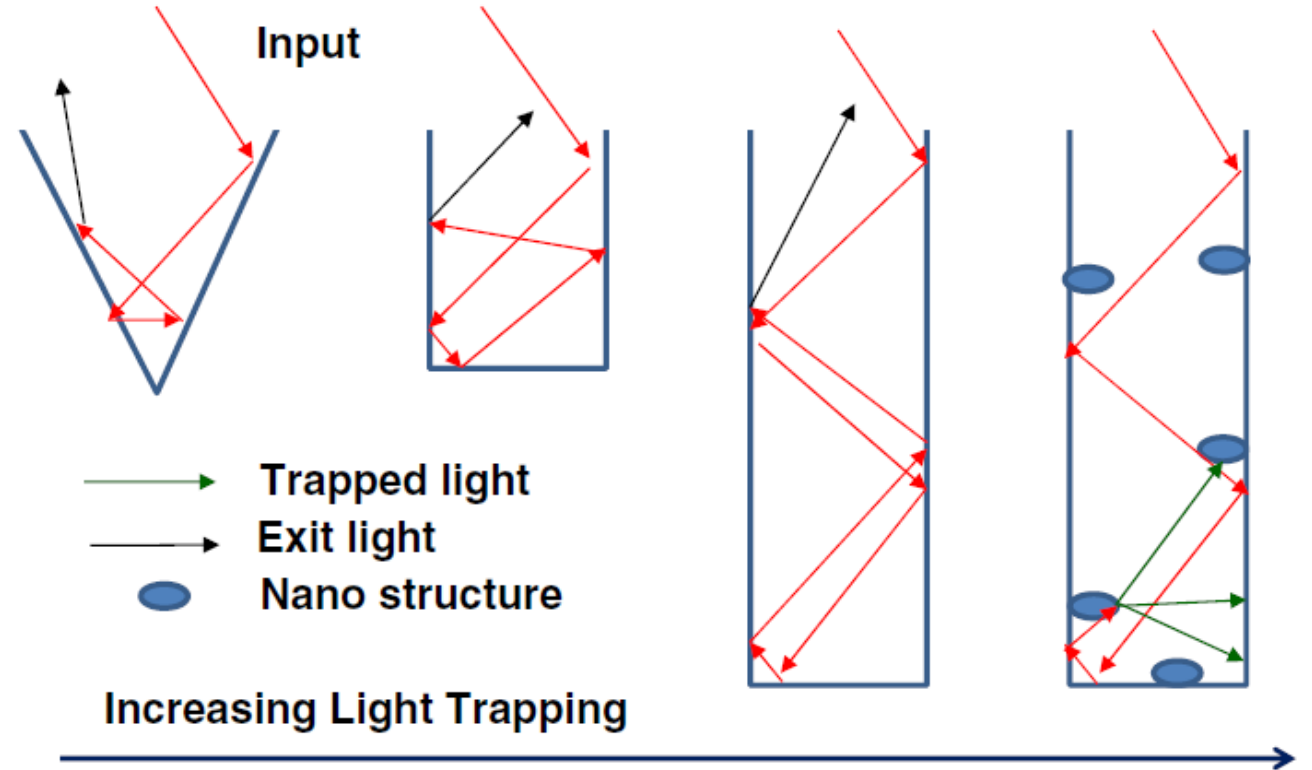
Cailing Fu, Oskar Hofmann

Microstructures

Laser Blackening

Principle

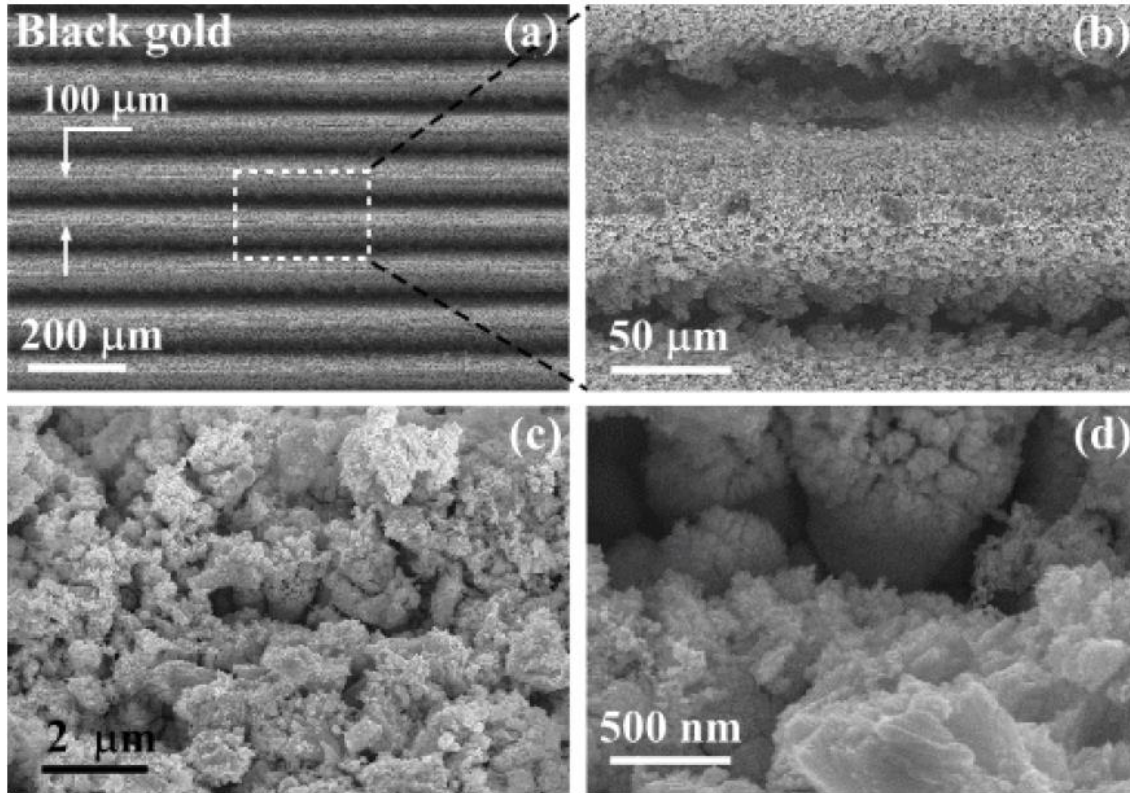
- Randomly distributed large hollow and small hole.
- The microstructures, nanostructures and particles on the wall of the holes strengthen the light trapping by blocking the collected light from escaping the cavities.



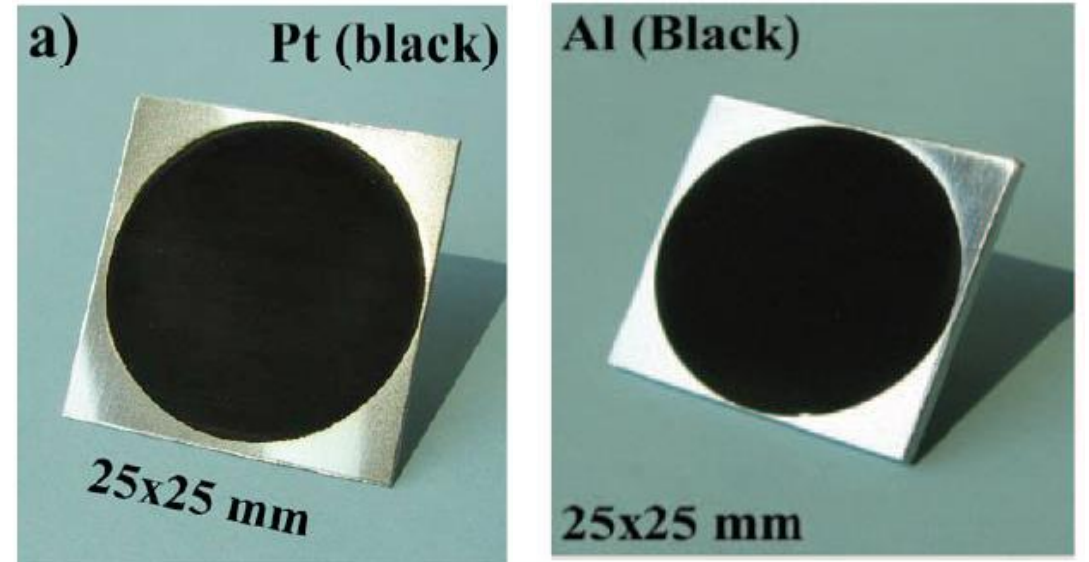
Huan Huang,* Lih-Mei Yang, Shuang Bai, and Jian Liu PolarOnyx , Blackening of metals using femtosecond fiber laser

Laser Blackening

Microstructure examples



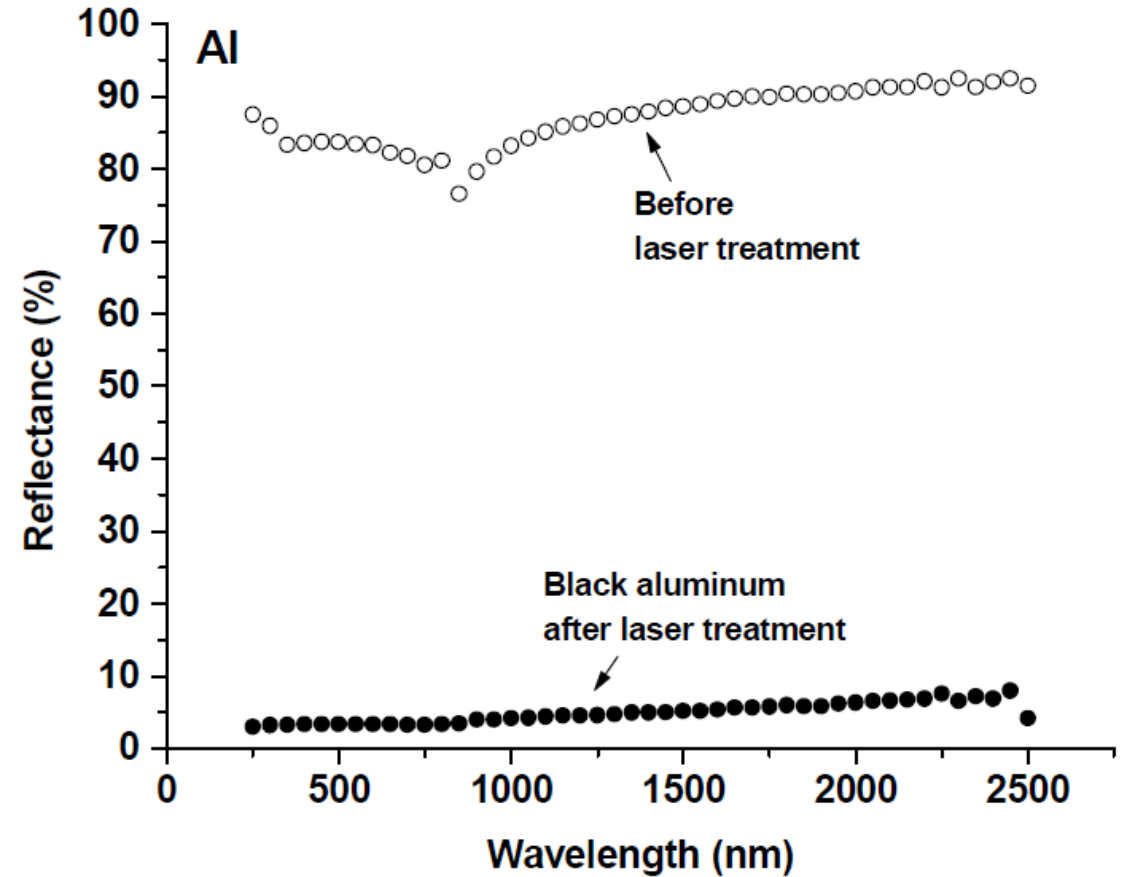
A. Y. Vorobyev and Chunlei Guo, Black Metals Through Femtosecond Laser Pulses



Laser Blackening

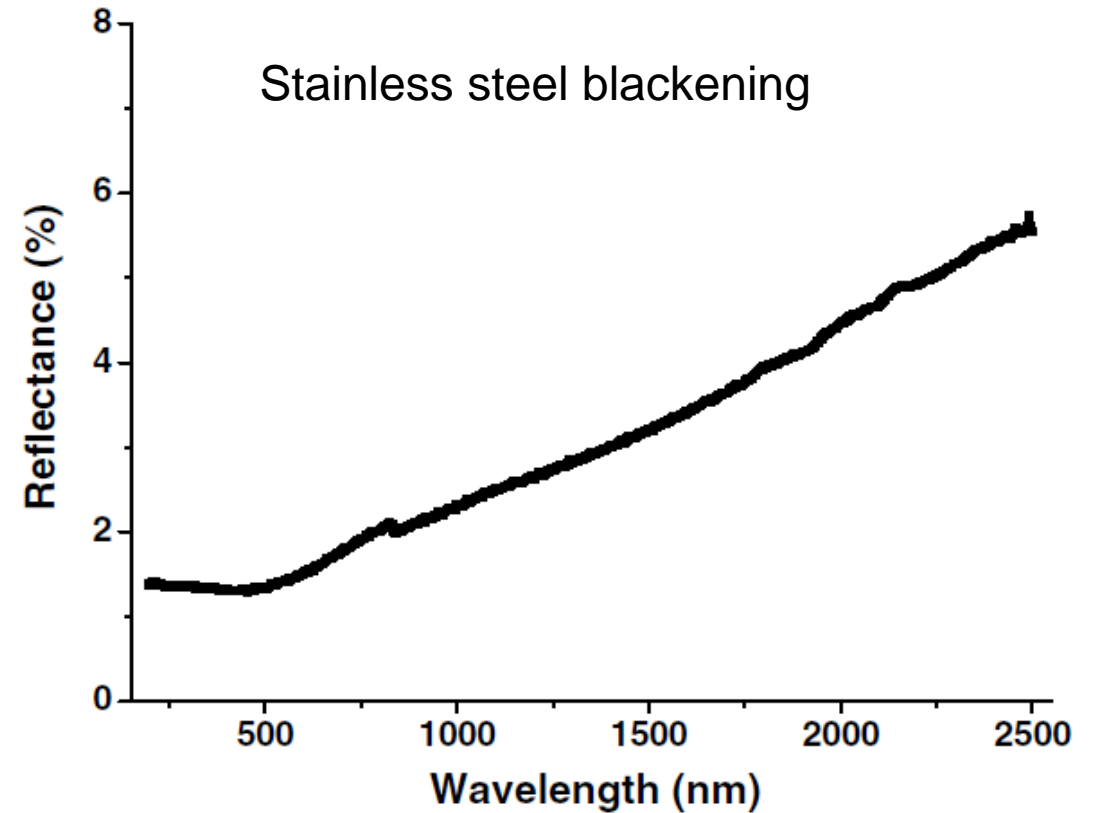
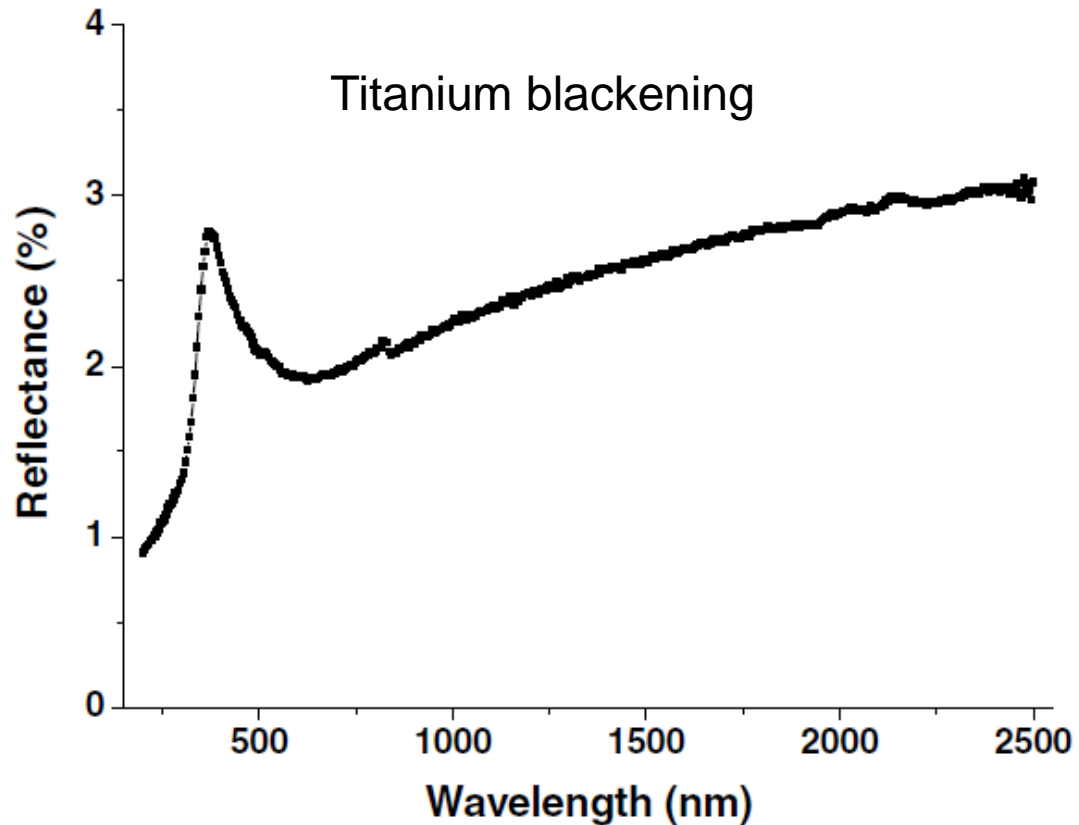
Reflectance of Black aluminum

- Reflectance of black Al at 1064 nm: 5%
- Reflectance of black Al at 1550 nm: under 10%, about 7%



Anatoliy Y. Vorobyev and Chunlei Guo, 2010, Solar Absorber Surfaces Treated by Femtosecond Laser

Reflectance of Black Titanium and Black Stainless Steel



Huan Huang,* Lih-Mei Yang, Shuang Bai, and Jian Liu PolarOnyx , Blackening of metals using femtosecond fiber laser

Coatings

Summary of the Existing Commercial Coatings

- Paints
- Plasma spray
- Anodization treatment
- Vapor deposition
 - Chemically vapor deposition (CVD)
 - Physical vapor deposition (PVD)

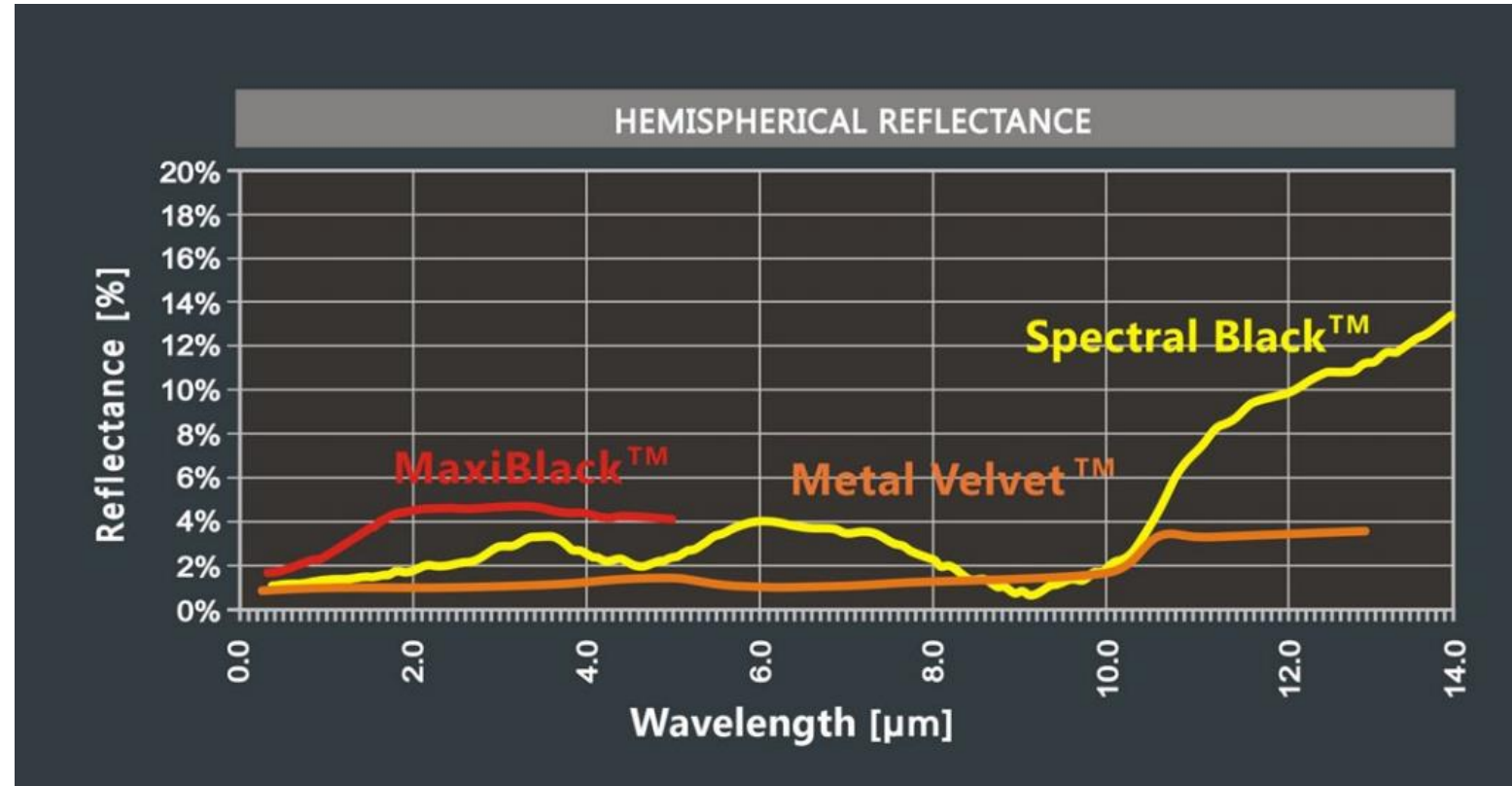
- We investigate
 - Acktar
 - Vantablack
 - Nanolab

Naoufal Bahlwane Charlotte
 Pachot, Ugo Lafont, 2016,
 Innovative CNT-based composite
 coatings for the stray light reduction.

Name	Absorptance (α)
Paints	
Carbon Black Paint NS-7	0.96
Catalac Black Paint	0.96
Chemglaze Black Paint Z3O6	0.96
Delrin Black Plastic	0.96
Ebanol C Black	0.97
Ebanol C Black-384 ESH* UV	0.97
GSFC Black Silicate MS-94	0.96
GSFC Black Paint 313-1	0.96
Hughson Black Paint H322	0.96
Hughson Black Paint L-300	0.95
Martin Black Paint N-15O-1	0.94
Martin Black Velvet Paint	0.91
3M Black Velvet Paint	0.97
Paladin Black Lacquer	0.95
Parsons Black Paint	0.98
Polyethylene Black Plastic	0.93
Pyramil Black on Beryllium Copper	0.92
Tedlar Black Plastic	0.94
Velesat Black Plastic	0.96
AMES 24E	0.99
DeSoto Black	0.97-0.98
Plasma	
Boron Black	0.89-0.97
Beryllium	0.99
Titanium	0.93
Anodized Aluminum	
Black	0,65-0.86
Metals and conversion coatings	
Black Cobalt	0.96
Black Chrome	0.96
Black Copper	0.98
Vapor deposition	
Acktar	0.97-0.99
Vantablack	0.9996

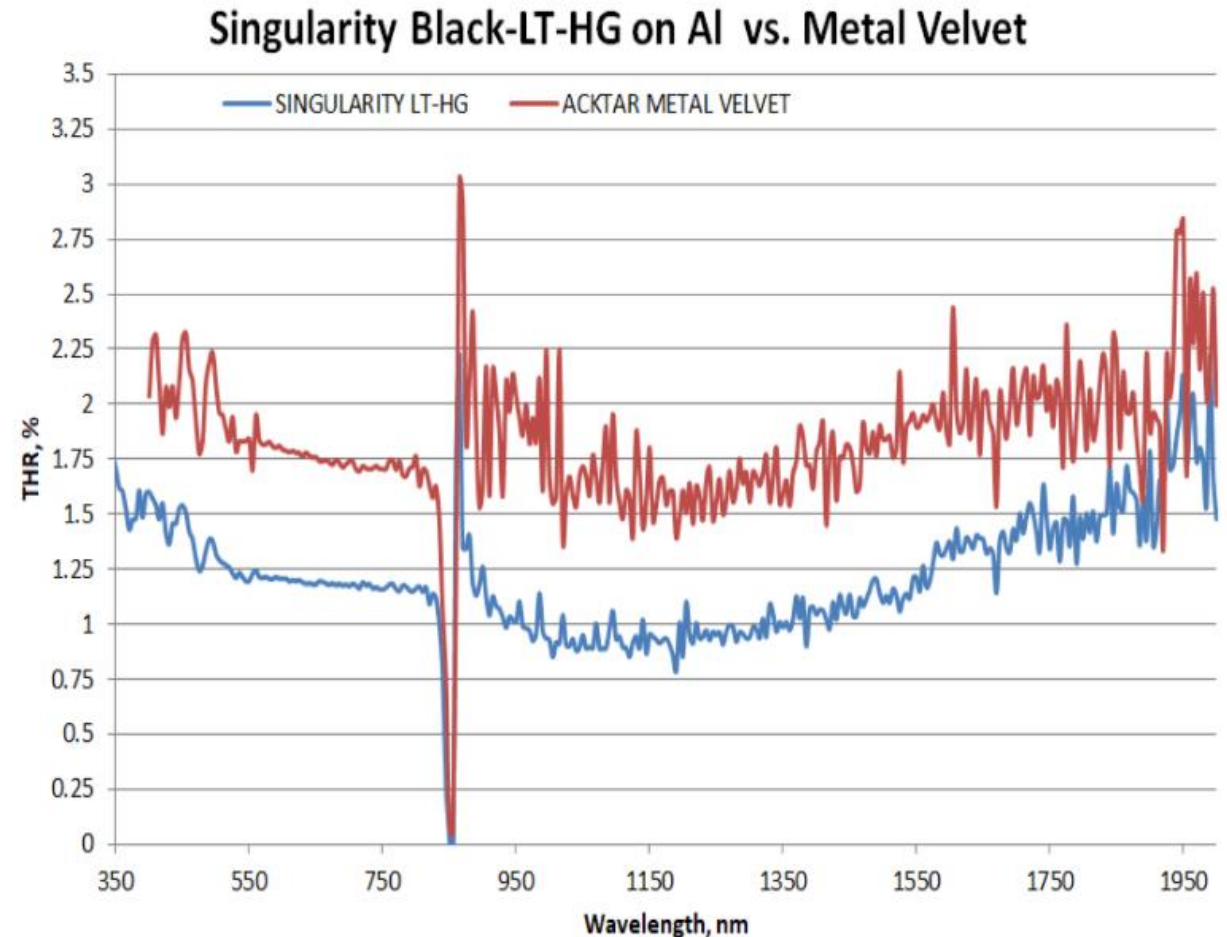
Acktar

- Total hemispherical reflectance (THR) for the wavelength from 1000 nm to 1550 nm < 1%
- We investigate **Metal Velvet**



Nanolab

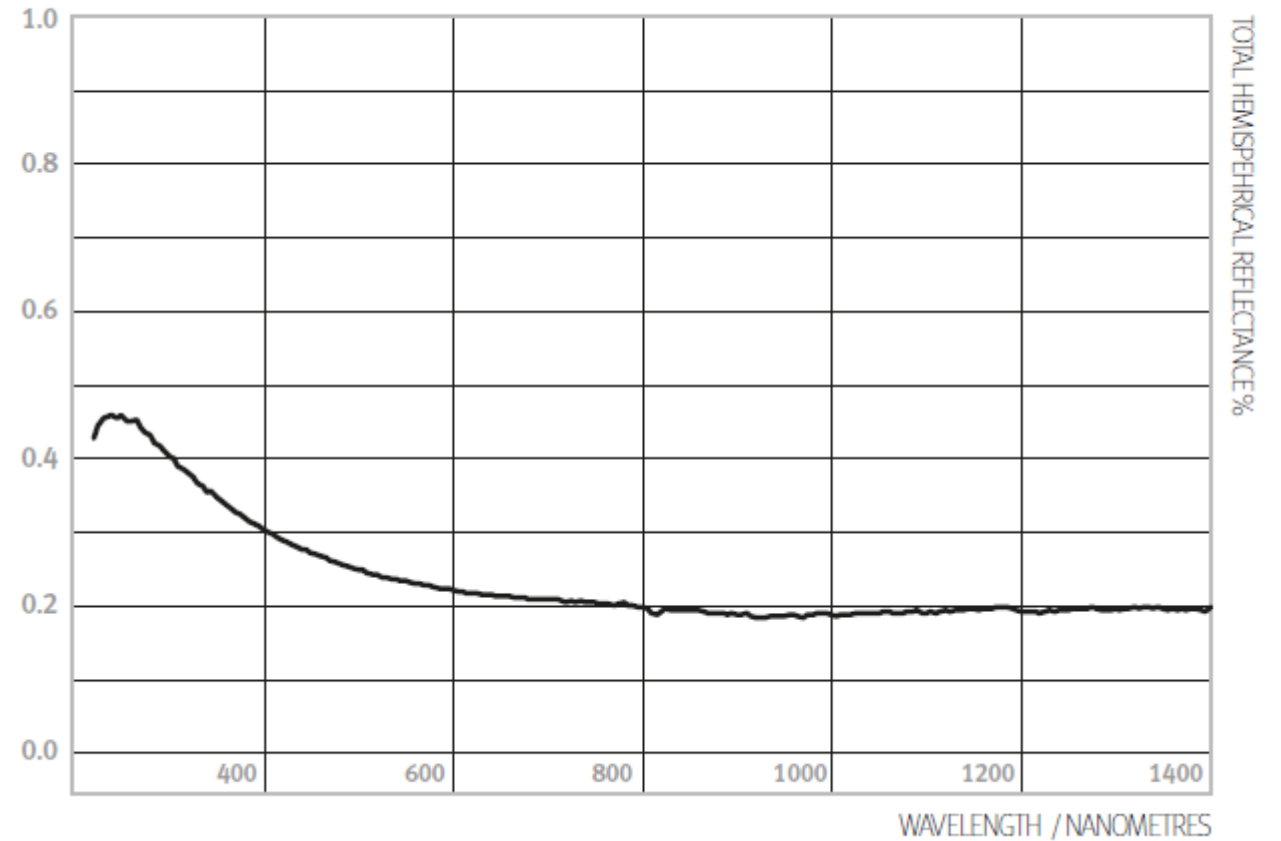
- **Singularity Black** and **Metal Velvet**
- THR of Singularity Black for the wavelength from 950 nm to 1550 nm: < 1.25%
- THR of Metal Velvet: >1.5% (discrepancy with the official data)



Vantablack S-VIS

- THR of wavelength from 800 to 1400: ~0.2%

Ultraviolet to near-infrared Hemispherical reflectance



Next Steps

- Measurement of
 - Reflection
 - Laser induced damage threshold
 - Performance in vacuum or low temperature

- Simulation of
 - Baffle Geometries
 - Temperature distribution in baffle

If you have informations or papers about this topic
→ Please contact us



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