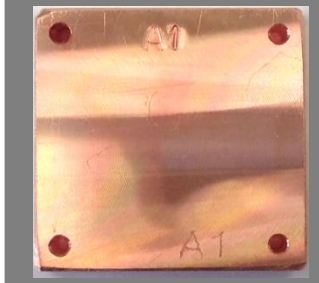
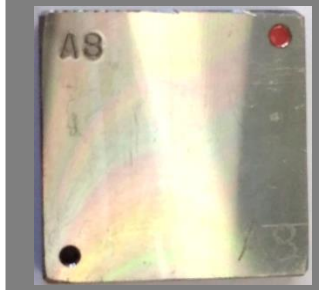
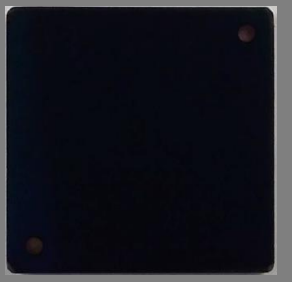
Blackening

BGC Collaboration Meeting – 27.11.2018

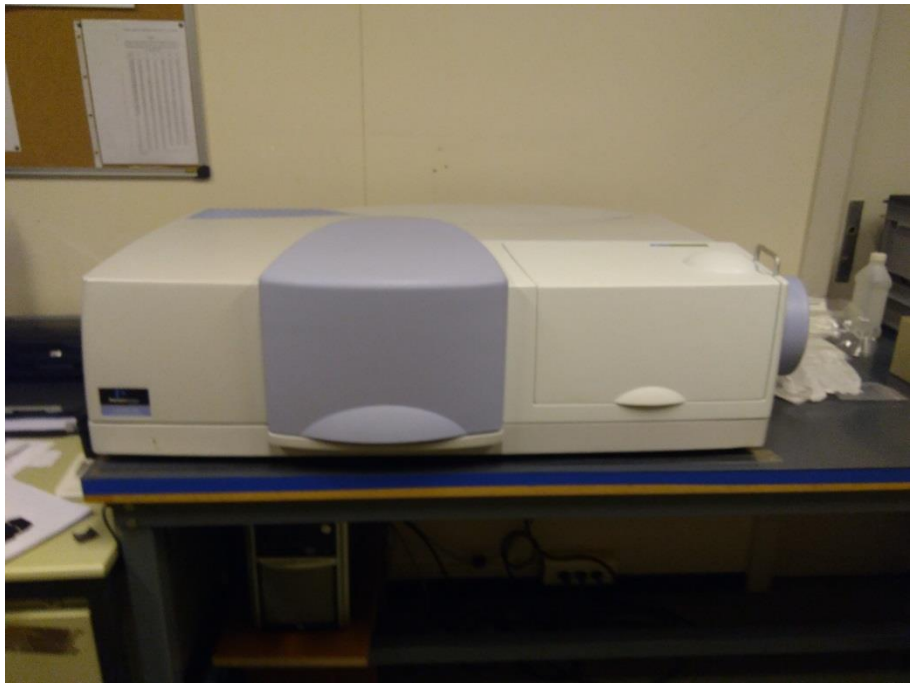
Requirements to Blackening

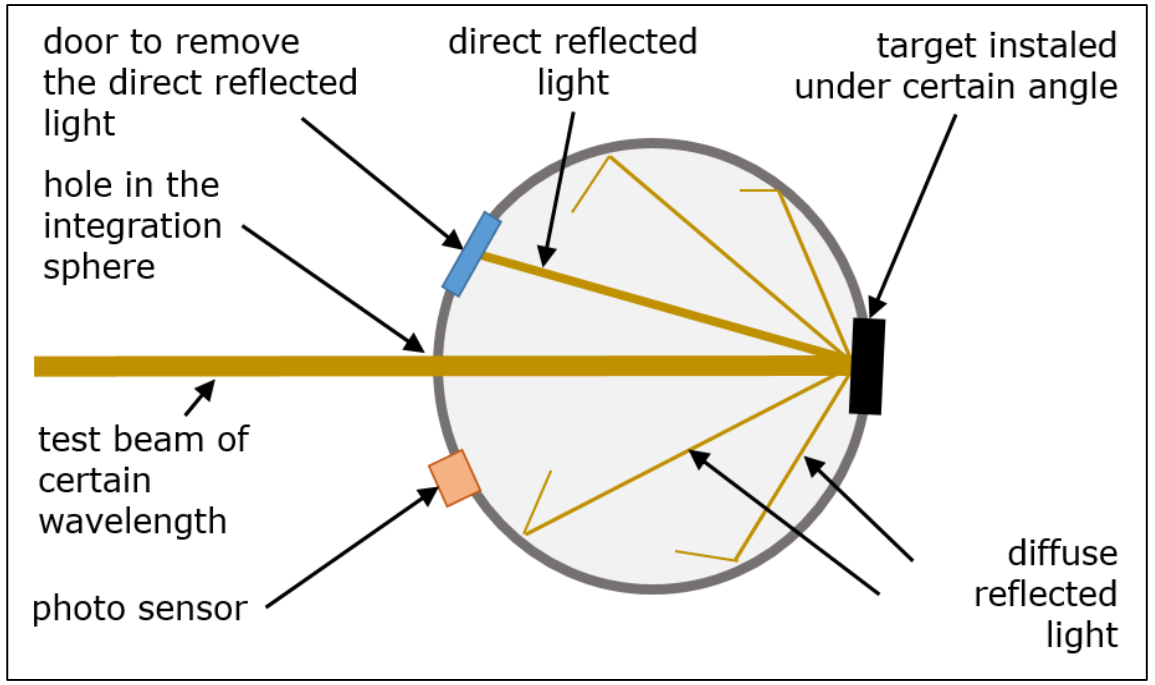
- Low reflectivity at wavelength 584nm
- Low outgassing rates
- Solid surface (no UFO issues)
- Suitable for bakeout

Reflectivity at neon wavelength 584nm

	Degreased no coating	NEG	Amorphous carbon	LESS (Dundee)	Multilayer sputtering (Polyteknik)
Copper	≈ 85% 	≈ 45% 	≈ 13% 	≈ 3.5% 	≈ 0.2% 
Steel	≈ 56% 	≈ 45% 	≈ 14% 	≈ 5.4% 	≈ 0.2% 

Spectrometer with Integration Sphere



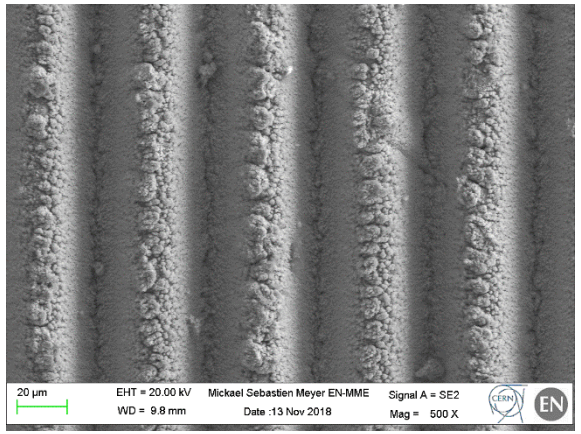


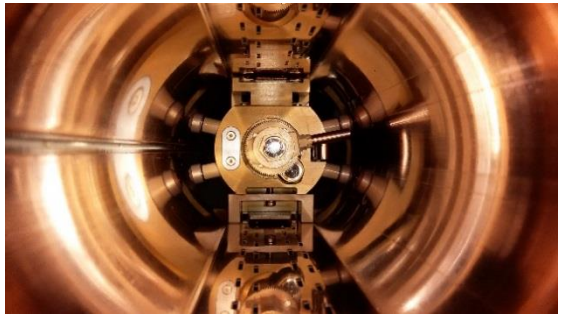
Amorphous Carbon (aC) (≈14% R)

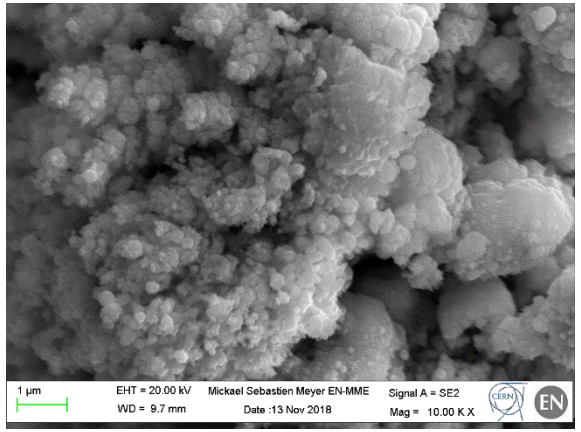
- Developed to lower the secondary electron yield of the beam screens
- Sputtering of long tubes can be done at CERN (wire sputtering)
  →Beam tubes before the interaction chamber
- Combination with LESS under investigation

Laser Engineered Surface Structures (University of Dundee) LESS (≈3.5% R)

- Developed to lower the secondary electron yield of the beam screens
- Micro structuring of the surface by laser → only the increased roughness changes the reflectivity
- Robot for laser treatment of beam screens was developed

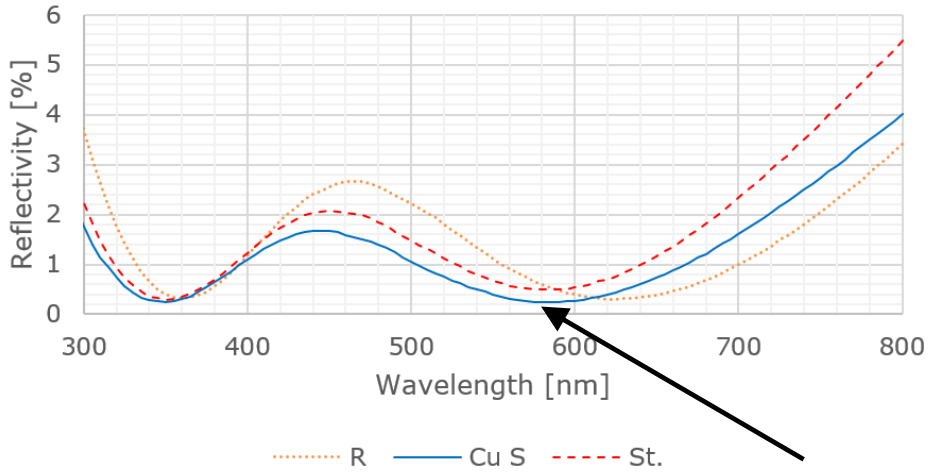






Polyteknik DK
Multilayer Sputering (≈0.2% R)

- Customized magnetron sputtering
- Lowest reflectivity of the tested samples



Minimum at requested wavelength

Inox Color
Chromium Oxide(≈15.2% R)

- Used at GSI, with good results
- Only steel can be coated (not the copper liner)

Combination of LESS with Coating

- Tests in progress to combine the effect of high roughness and a dark material
  → Coating of the LESS samples with amorphous carbon

Recommendations

- Copper liner: LESS (with aC?) or Multilayer Sputtering
  - Disc with best black solution screwed to the copper liner: in the background of the optics → step to prevent direct reflection of synchrotron radiation
- Interaction camber: aC or chromium oxide

Not suitable coatings

- Vantablack (Surrey NanoSystems) based on nano tube technologies (≈0.3%R)
  → UFO issues, geometry restricted to 400x400x200mm
- Agar Scientific produces coatings for optical parts (≈1.5%R)
  → Geometrical restrictions, problems with undercuts