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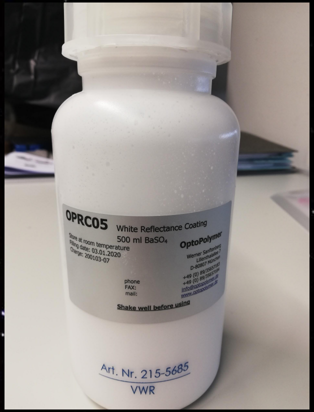
Spray Coating of Liquid Scintillator Cells with UV-Reflective Paint

Bundesministerium für Bildung und Forschung

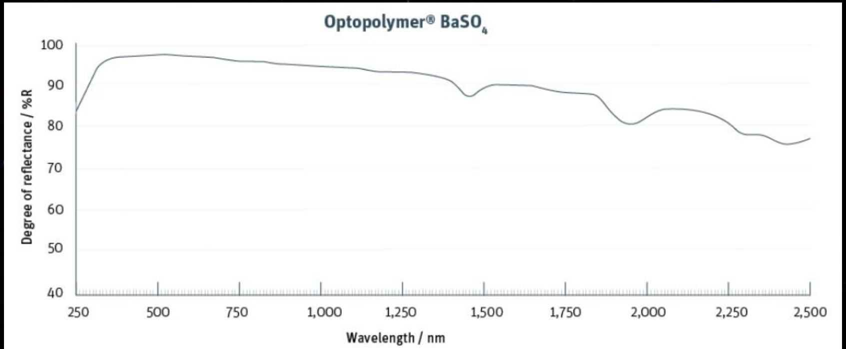
02.09.2022
High-D-Consortium-Meeting
Patrick Deucher

Recap

- Enhanced detector light collection
  - purification of LS
  - light shifting to transparent region of LS
  - **increased reflectivity**
- Photon Transport Simulation: increase of light yield by factor 4-5
- Most promising candidate: “Bariumsulfate (BaSO4) Coating OPRC” from Berghof Fluoroplastics
  - efficient diffuse reflector in UV-region
  - chemically stable in contact with LS and stainless steel
  - physical stability needs to be increased



OPRC Coating



Reflectivity of OPRC from Manufacturer

Overview

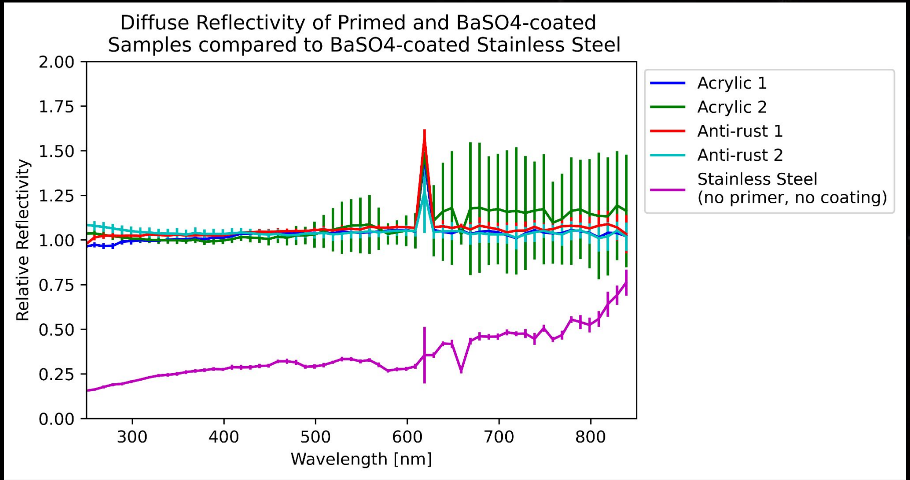
- First use of cheaper Corten Steel (reacts with OPRC Coating)
- Primers for increased physical stability of coating and protective layer between steel and coating
- Impact of four primers and Corten steel on scintillator quality and reflectivity are investigated through aging tests
    - Samples submerged in scintillator: 5 weeks, 60°C → ~ 1.5 years, RT

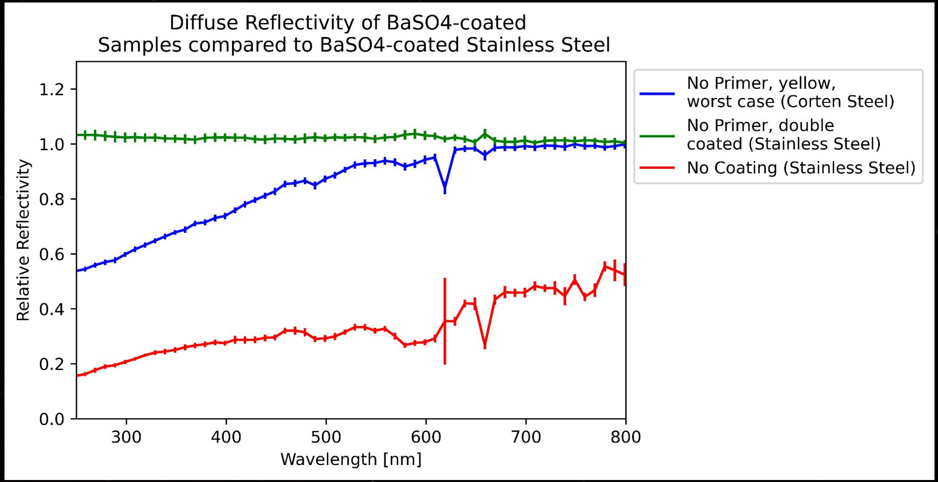
Overview of reflective samples

Corten Steel Structure

Yellowish coating after direkt application

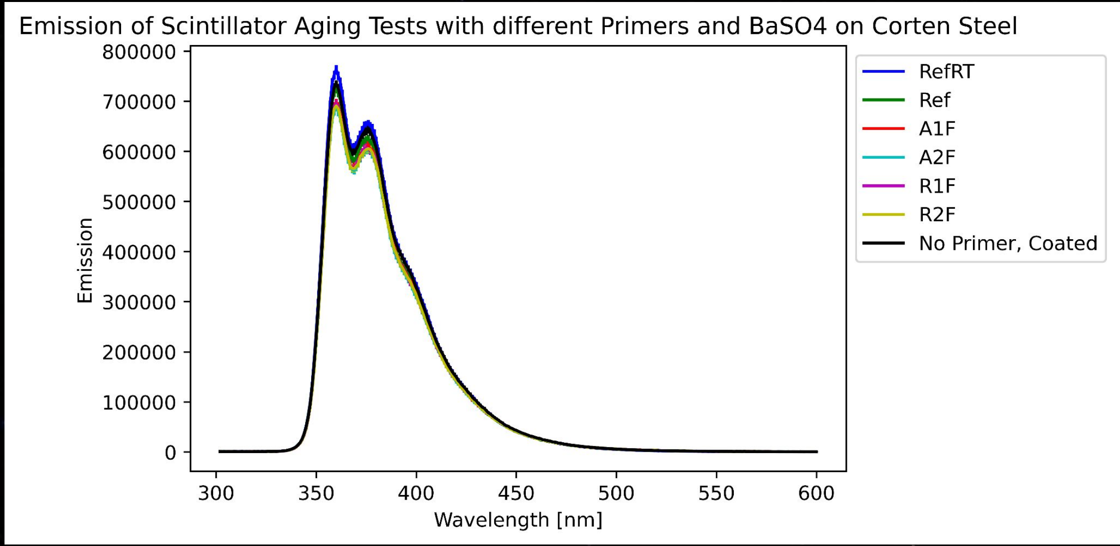
Diffuse Reflectivity Measurements before Aging





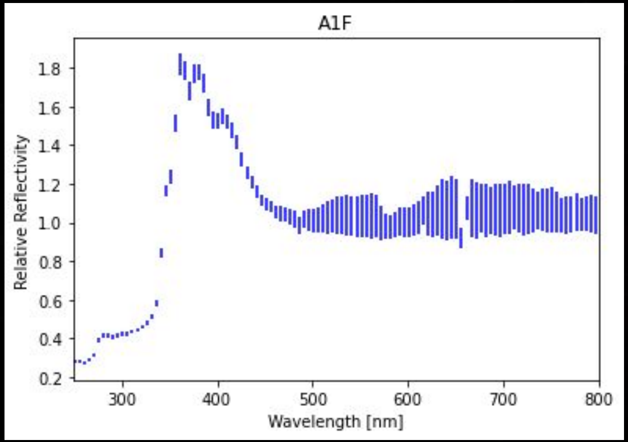
- reflectivity is independent of primer
- increase of diffuse reflectivity of factor 4 compared to stainless steel (400 nm)
- double coating does not increase reflectivity
- yellowish coating (worst case) still increases reflectivity significantly

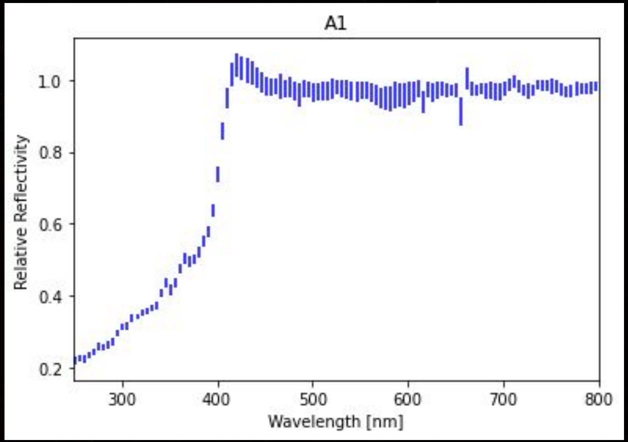
Aged Scintillator Comparison: Emission

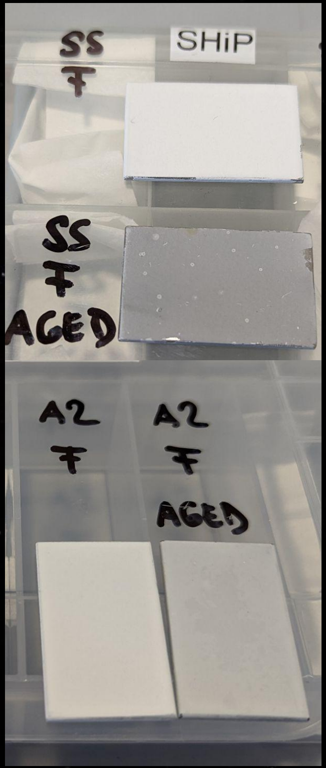


- no significant change in scintillator emission properties
- all scintillators with primed and coated samples have almost identical emission
- transmission measurements also show no significant change in quality

Aged Sample Reflectivity Comparison





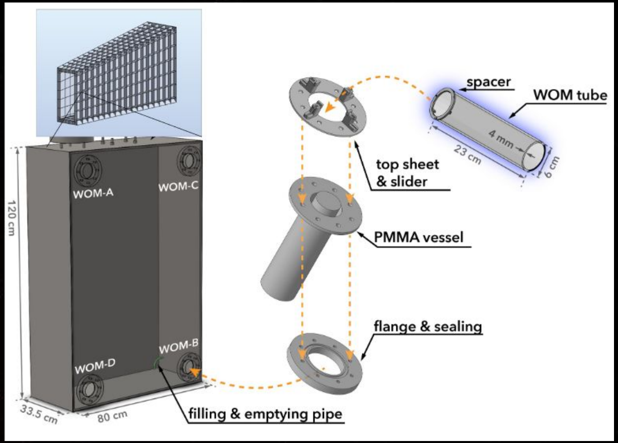


Comparison of unaged/aged reflective samples

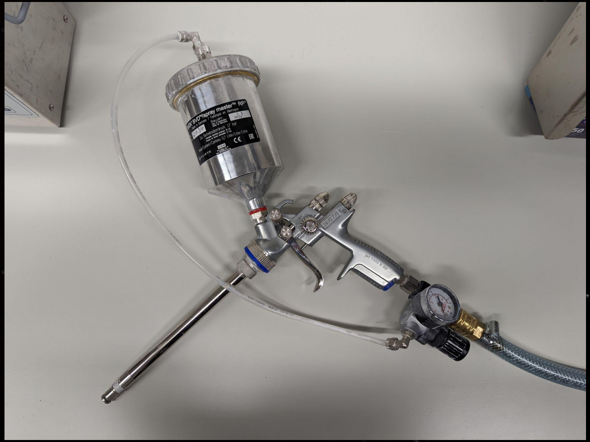
- OPRC absorbs scintillator
- true reflectivity will be measured with different lamp spectrum to exclude WLS
- primer has low scintillator absorption potential
- additional protective coating ?

Application of the Coating

- application after welding to ensure stability of the coating
- access through WOM entry points
- radial nozzle for SATAjet spray gun to coat the inner walls
- additional 90° nozzle for more efficient coating of the wall with entry points



Overview of WOM-LS Detector



Assembled Spray Gun with radial Nozzle and pressure cup

First Coating Attempts

Conclusion and Outlook

- OPRC shows promising properties to be used as a reflective coating on the inner walls of WOM-LS detectors
- primers enhance physical stability of the coating and implement a protective layer between OPRC and steel
- Corten Steel, Primers and OPRC show no significant negative effect on scintillator quality
- Outlook:
  - Reflectivity measurements of aged reflective samples
  - Investigation of potential protective coating
  - Optimization of spray coating process
  - Coating of a Prototype Detector for SHiP SBT test beam at Desy in October 2022