

Figure 1: Hemispherical reflectance spectra

Key Parameters

- ρ_{SWH} = solar weighted hemispherical reflectance
- ρ_{SWD} = solar weighted direct reflectance within acceptance angle of 25 mrad
- $\zeta_{hem,n}$ & $\zeta_{direct,n}$ = reduced hemispherical and reduced direct reflectance after n cycles of abrasion
- α_{spec} = angle of specular beam diversion

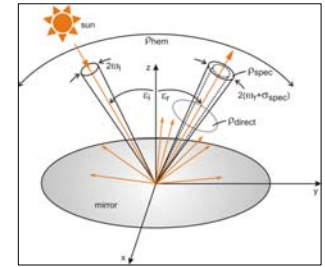


Figure 3: Scheme of reflection

Optical properties of example materials

	Glass mirror	Polymer film	Aluminum 1	Aluminum 2
ρ_{SWH}	0.939	0.922	0.903	0.868
ρ_{SWD}	0.939	0.874	0.830	0.835
α_{spec}	<< 0.3 mrad	0.9 mrad	1.2 mrad	0.8 mrad

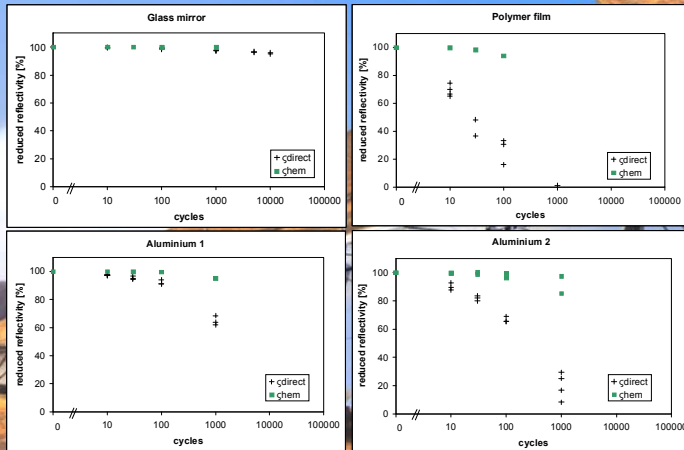


Figure 2: Abrasion testing

Results

- Specular beam diversion is small on all samples, but samples other than glass show relevant diffuse reflectance.
- The durability of the mirror surface can be characterized with the abrasive test and reveals major differences between materials.
- The essential value for mirror quality is ρ_{SWD} at 25 mrad acceptance angle (valid for parabolic trough technology).

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Optical Characterization of Reflector Material for Concentrating Solar Power (CSP) Technology

Objective

- The collector mirror is a key component for CSP technology with challenging quality requirements. High specular reflectivity of the solar radiation has to be maintained over a long lifetime.
- Reflectance differences of only a few percent strongly influence power plant efficiency and electricity cost.
- The DLR QUARZ-Center has recently developed a measurement procedure to characterize the optical properties of mirror materials and provide a reliable and independent quality evaluation.

Procedure

- Different instruments are used to measure the key parameters of reflectivity listed above.
- The results are weighted with the actual standard solar spectrum (ASTM G173).
- Samples are also subjected to an abrasion test and measured again to obtain the reduced reflectance values, which can be used to estimate their durability.
- For CSP applications the direct reflectance value quantifies the amount of solar irradiance concentrated onto the absorber and is therefore the most relevant qualification parameter.



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