# measurement report

**S2(^): batch C117I054**
**HR(0°,1030nm)>99.997% (low loss)**
**T<0.001% (coating not ps-optimized)**
**Goal: HR(0°,1030nm)>99.998%**

**S1: batch C117I057**
**AR(0°,1010-1070nm)<0.2%**

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## Determination of reflectance (R) by transmittance measurements

### Optical properties of sputtered dielectric coatings

Sputtered optical coatings for the VIS and NIR exhibit extremely low scattered light and absorption losses (both in the order of some $10^{-5}$... $10^{-4}$). This has been confirmed by direct measurements of scattered light and absorption as well as by highly accurate reflectance measurements (e.g. by cavity ring down spectroscopy). Knowing these very small optical losses, the reflectance of sputtered mirrors can be determined by measuring the transmittance T and the simple calculation R=100% - T - A

### Transmittance measurement vs. reflectance measurement of optical coatings using spectrophotometry

In a normal spectrophotometer, the transmittance can be measured with an accuracy of about 0.1...0.2% (depending on the absolute value), whereas reflectance measurements in spectrophotometers mostly have errors of about 0.5%. Thus, the determination of the reflectance of sputtered coatings in the VIS and NIR by transmittance measurements is much more accurate than direct reflectance measurements.

### Procedure of indirect determination of the reflectance for any given AOI by transmittance measurements at AOI=0°

AOI (angle of incidence = angle between the incident beam and the surface normal of the substrate).

As explained above it is possible to determine the reflectance on the base of transmittance measurements at AOI=0°. The procedure is the following:

First the transmittance at 0° incidence angle is measured (dashed line in fig.1). Computer algorithms recalculate the theoretical design to adapt to the measured spectrum until the theoretical transmittance (continuous line in fig.1) matches as good as possible to the measured spectral data.

Hence all errors which may occur during the coating process (e.g. slight deviation of the sputter rate with growing number of layers, rising substrate temperature etc.) can be taken into account.

This procedure provides the real design of the coating enabling us to estimate many optical properties.

This method proved to be very accurate.

**fig. 1**
transmittance measurement 0° (- - - - -)
refined theoretical design 0° (_____ )

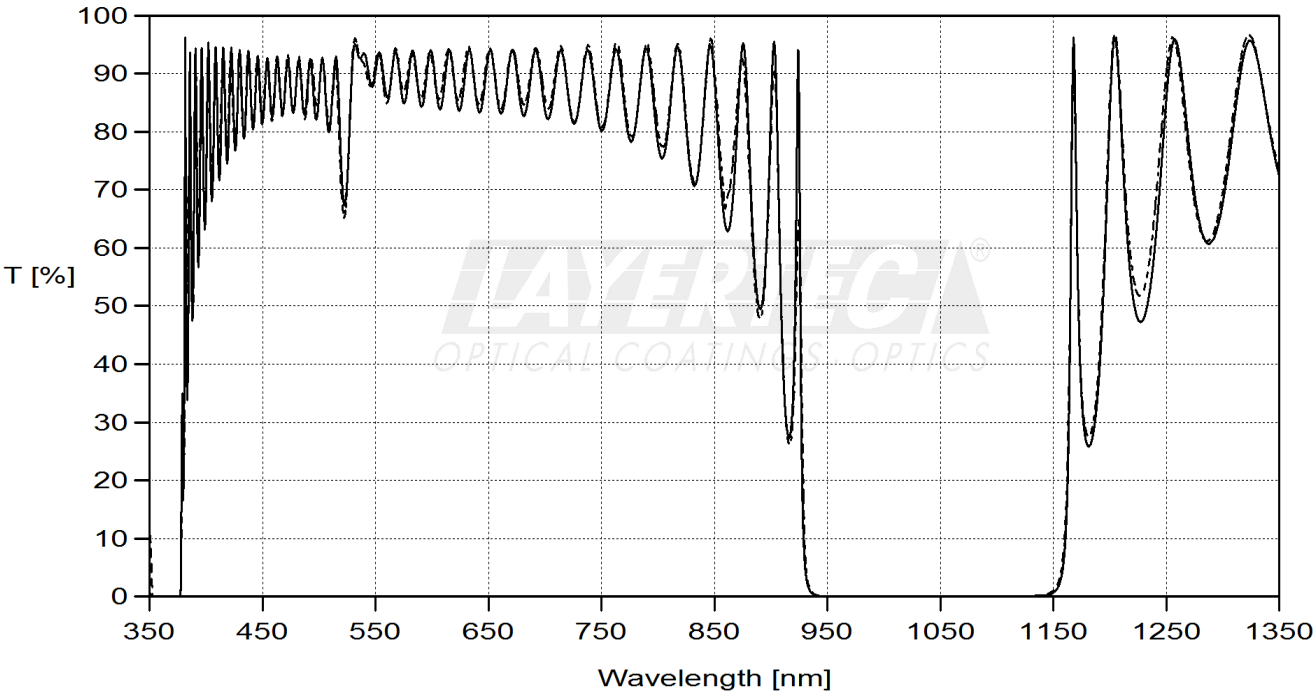


**fig. 2:**
calculated reflectance at 0°- S2 (based on refined th. design fig. 1)

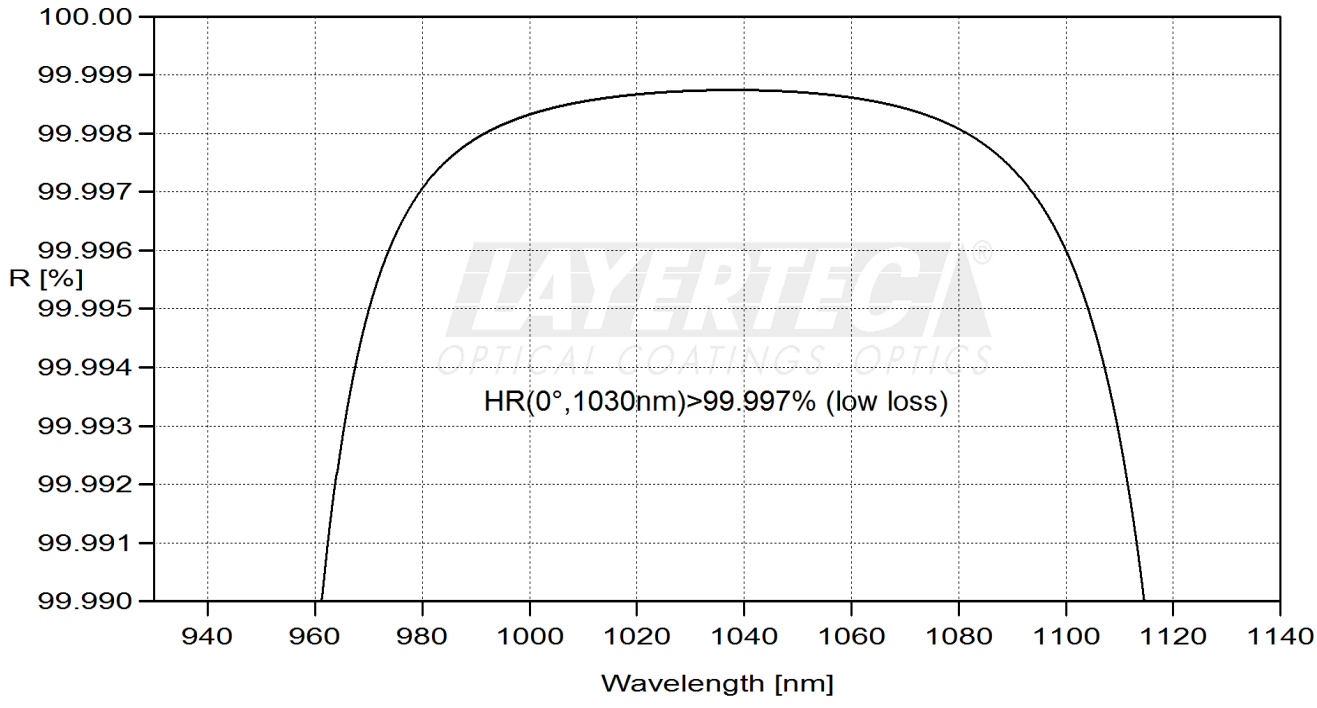

**fig. 3:**
calculated transmittance of S2 at 0°  (based on refined th. design fig. 1)

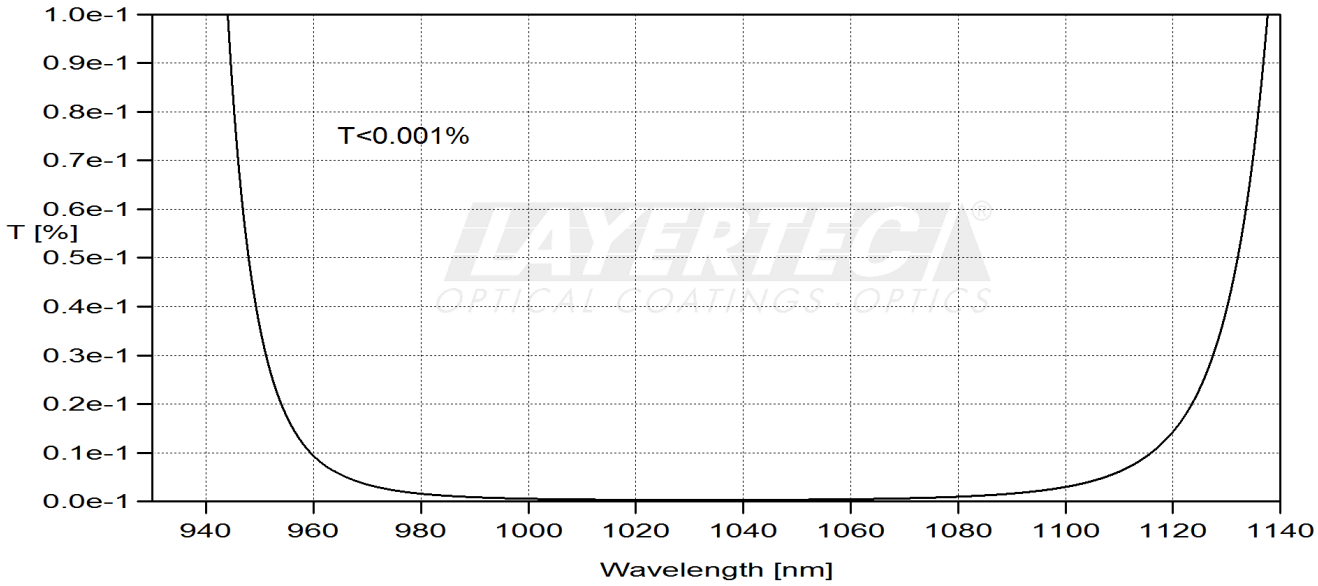


**fig. 4:**
calculated rear side AR at 0°