



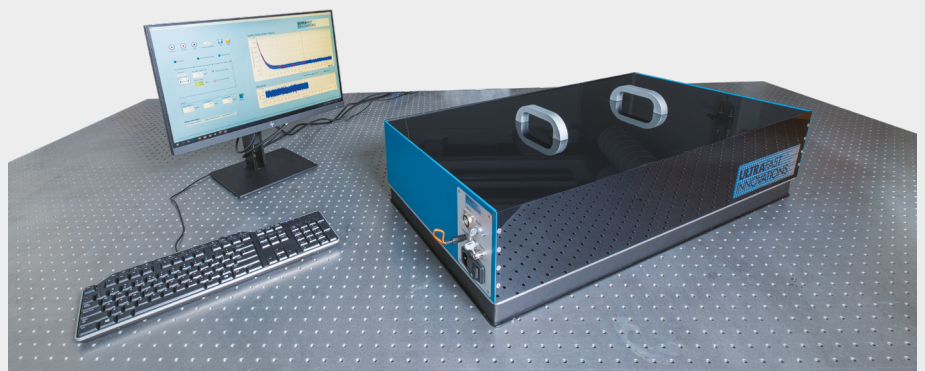
**UltraFast**  
Innovations

YOUR KEY to innovation and success



## Cavity-Ringdown (CRD) Reflectometer and Loss Meter GLACIER

Our reflectometer GLACIER uses the extreme sensitivity of cavity ring-down spectroscopy to quantify the losses of advanced optical coatings down to 5 ppm. As a typical application the device can characterize supra-mirrors with up to 99.9995% reflectivity. Conventional absorption and reflection measurements are not sufficiently sensitive to quantify today's super-reflective mirror coatings and are typically limited to the >1000 ppm range (corresponding to < 99.9% reflectivity). Cavity ring-down spectroscopy measures optical losses by the decay of the energy stored inside a cavity. The technique reaches unrivalled sensitivity, because losses



are experienced with each round trip inside the cavity over and over again. Smaller losses lead to longer intra-cavity dwell time thereby automatically increasing measurement precision. The device features high-speed data

acquisition and allows to record measurements within seconds. It is delivered complete with a computer and a user-friendly software interface for acquisition and real-time analysis.

### Key Product Features:

- Reflectivity measurements**
  - Reflectivities up to 99.9995%
  - Various angles of incidence: 5°-45° (and 0°)
  - s and p polarization (separately)
- Antireflective coating characterization**  
Reflectivity down to 0.0005% (5 ppm)
- Simple and reproducible alignment**  
for 0.5", 1" and 2" optics
- Spring-loaded mirror fixtures**  
for reproducible mounting without strain
- Computer and user-friendly software interface included**
- High-speed data acquisition and real-time analysis**  
Complete measurement and analysis within seconds
- Available wavelengths**  
375-1550 nm  
other wavelengths are available upon request
- Footprint**  
90 x 45 cm<sup>2</sup> (standard size)

UltraFast Innovations GmbH  
Am Coulombwall 1  
85748 Garching  
Germany

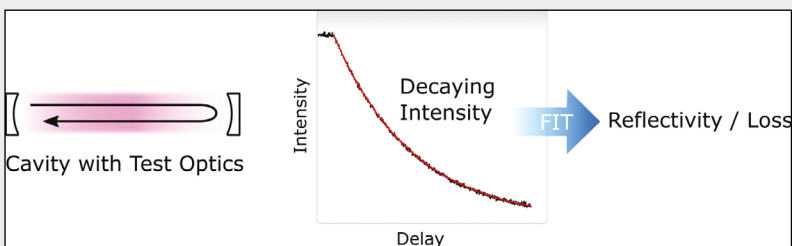
tel. +49 89 36039 - 437  
fax. +49 89 36039 - 453  
info@ultrafast-innovations.com  
www.ultrafast-innovations.com



	GLACIER	GLACIER <sup>+</sup>	GLACIER <sup>++</sup>
<b>Number of wavelengths</b>	One	Two	Three
<b>Wavelength range</b>	375-1550 nm	375-1550 nm	375-1550 nm
<b>Footprint</b>	90 x 45 cm <sup>2</sup>	90 x 55 cm <sup>2</sup>	

### Working Principle:

GLACIER uses the principle of reflectivity/loss measurements with cavity ring-down spectroscopy is based on very low losses at each mirror bounce. Pulses travelling inside a cavity experience optical losses over and over again during each round trip.



*Sketch of the working principle of our cavity ring-down device including measurement and fitting procedure.*

The device measures the time-dependent intensity  $I(t)$  leaked through an end mirror of the cavity (center). The signal decays with a time constant depending on the intra-cavity losses and can be fitted to an exponential function of the form:

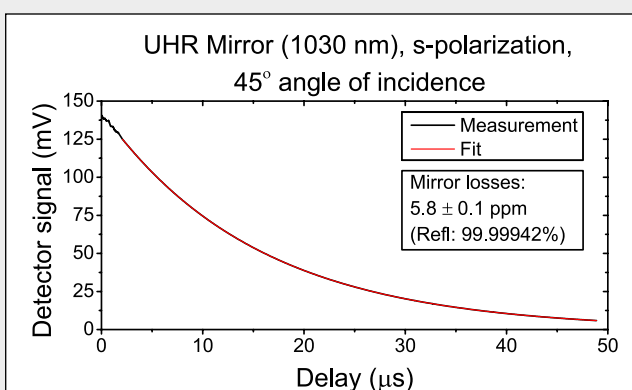
$$I(t) = I(t_0) \times \exp\left(-\frac{t}{\tau}\right)$$

The time constant  $\tau$  is inversely proportional to the optical losses  $(1-R)$  of the cavity with total reflectivity  $R$ :

$$\tau = \frac{n}{c} \times \frac{l}{(1-R)}$$

where  $n$  is the refractive index,  $c$  is the speed of light, and  $l$  is the cavity length.

### Sample Measurement:



*The figure to the left shows a typical GLACIER measurement of an ultrahigh-reflective mirror for 1030 nm. The losses of the test mirror were obtained by subtracting the results of a reference measurement with an empty cavity. Therefore, an absolute measurement of the test mirror is realized.*