Technical Information · Optical Glass
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Faraday effect and Verdet constant of some optical glasses

When plane-polarized light passes through a light-transmitting body (glass) in parallel with the lines of force of a magnetic field $\mathfrak{H}$, the direction of polarization of the light is turned by the angle α .

$$\alpha = V \cdot B \cdot \ell$$

wherein H is the magnetic field intensity in Oe, and ℓ the layer thickness in cm of the glass body penetrated by rays. The Verdet constant V is a function of the wave length.

$$V = \frac{e_o}{m_o} \cdot \frac{\lambda}{2c} \cdot \frac{dn}{d\lambda}$$

wherein e_o/m_o is the specific charge of the electrons, c the velocity of light and n the refractive index of the unmagnetized glass at the wave length λ . The Verdet constant is given in angular minutes per Oerstedt and centimeters of layer thickness.

Applications:

The rotation of the plane of polarization, or the optical activity due to circular birefringence of the glasses in the magnetic field, is used for inertialess optical shutters. An optical path of rays can be interrupted or modulated once or very frequently by switching the magnetic field.

In laser technology, Faraday glasses are used as "one-way streets for light" because plane-polarized light can only in one direction pass through a corresponding combination of the glass with polarizers.

- 2 -

Due to the laser technology, there is an increasing significance of glasses with a high Faraday effect. Data are, therefore, supplied for the internal transmittance τ_i and for the load capacity of the glasses for laser radiation. The destruction threshold in joules/cm^2 of the glass is given for the effect of a laser pulse of 40 nsec.

1) Verdet constant in angular minutes/Oe · cm

For some glass types are given the mean values from several glass melts. The accuracy of measurement is for the visible region of the spectrum: $\pm 2 \cdot 10^{-3}$; for 1,060 nm: $\pm 3 \cdot 10^{-3}$. For the glass type SF 59, the accuracy of measurement is $\pm 1 \cdot 10^{-2}$ for 435,8 nm and 450 nm.

Glass type	Wave length (nm)									
	435,8	450	480	500	546,1	580	589,3	600	632,8	1060
SF 59	0,24	0,22	0,178	0,160	0,128	0,111	0,107	0,102	0,089	0,028
SF 58	0,217	0,196	0,164	0,147	0,118	0,102	0,098	0,094	0,082	0,026
SF 57+	0,180	0,163	0,136	0,122	0,099	0,085	0,082	0,079	0,069	0,023
SF 6	0,155	0,142	0,120	0,108	0,087	0,076	0,073	0,070	0,061	0,021
SF 1	0,120	0,110	0,093	0,084	0,068	0,059	0,056	0,054	0,047	0,017
SF 5	0,102	0,094	0,079	0,072	0,058	0,050	0,048	0,046	0,041	0,014
SF 2	0,093	0,085	0,072	0,065	0,053	0,046	0,045	0,043	0,038	0,013
F 2	0,083	0,076	0,064	0,058	0,047	0,041	0,040	0,038	0,034	0,012
BK 7	0,033	0,031	0,026	0,024	0,020	0,017	0,017	0,016	0,014	0,006

+) SF 57 is the so-called Pockels glass which can be supplied with reduced stress birefringence. The stress-optical coefficient is nearly zero.

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No. 11/3

2) Internal transmittance at 25 mm of layer thickness and load capacity for laser light

Glass type	Internal transmittance τ_i 1)			Destruction threshold 2) for laser light at q-switch pulses of a duration of 40 nsec in joules/cm^2
	λ = 435,8 nm	λ = 546,1 nm	λ = 1060 nm	
SF 59	0,61	0,975	0,996	6
SF 58	0,86	0,999	0,999	7
SF 57	0,95	0,999	0,999	8
SF 6	0,95	0,999	0,999	10
SF 1	0,982	0,999	0,999	15
SF 5	0,989	0,998	0,999	19
SF 2	0,998	0,999	0,999	25
F 2	0,992	0,999	0,999	30
BK 7	0,992	0,996	0,999	80

1) Mean value from different glass melts.

2) Statistical measured value which shall not be attained in field applications. The probability of destruction increases with the approximation to this value.