

# IOG-1 Phosphate Laser Glass

For Ion Exchange Applications

IOG-1 is a chemically durable, sodium-alumino-phosphate glass developed for use in active and passive waveguide devices, which are fabricated by ion exchange in a molten  $\text{KNO}_3$  or  $\text{AgNO}_3$  salt bath. Cumulative  $\text{Er}_2\text{O}_3$  and  $\text{Yb}_2\text{O}_3$  doping levels can be selected anywhere from 0 to 20wt%. IOG-1 devices are discussed in "Arrays of distributed-Bragg-reflector waveguide lasers at 1536 nm in Yb/Er codoped phosphate glass," Appl. Phys. Lett., Vol 74(6), 789-791 (1999).

Optical Properties	
$n_d$	1.523
$v_d$	67.5
$n_{1000\text{nm}}$ (calculated)	1.515
$n_{1540\text{m}}$ (calculated)	1.513

Erbium Laser Properties	
Emission Maxima, $\lambda$ (nm)	1534
Emission Cross Section at 1534 nm ( $10^{-21} \text{ cm}^2$ )	6.6
Excited State Lifetime for the 1534 nm Band (ms)	10.7
Max Absorption Cross Section for 980nm Pump Band ( $10^{-21} \text{ cm}^2$ )	2.0

Ytterbium Laser Properties	
Emission Maxima, $\lambda$ (nm)	1002
Emission Cross Section at 1002 nm ( $10^{-21} \text{ cm}^2$ )	5.4
Excited State Lifetime for the 1002 nm Band (ms)	1.4
Max Absorption Cross Section for 980nm Pump Band ( $10^{-21} \text{ cm}^2$ )	14.5

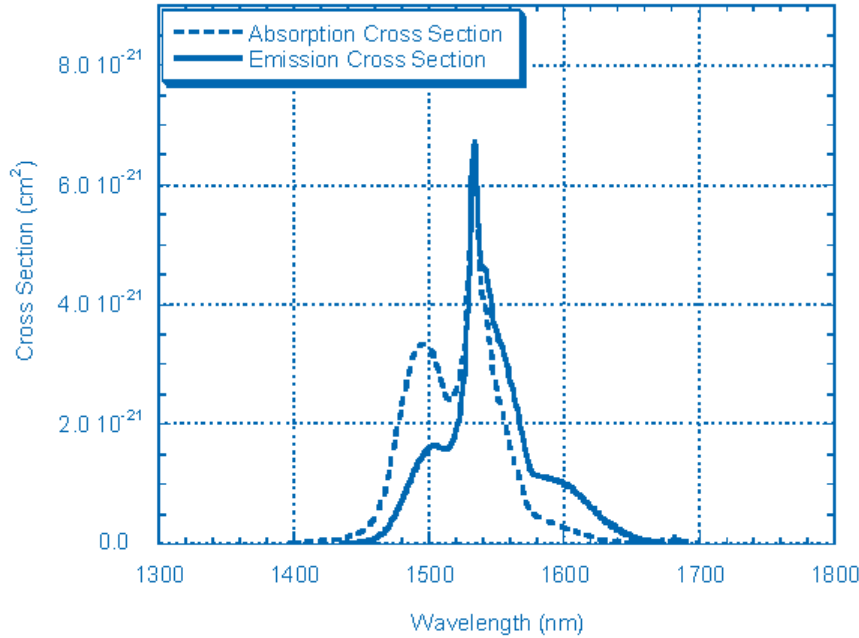
Chemical Properties	
Weight Loss in 50°C Water (mg/( $\text{cm}^2 \cdot \text{day}$ ))	0.012
Acid Resistance SR pH=0.3 at 25°C	3.0
Alkali Resistance AR pH=12 at 50°C	4.3
Staining Resistance FR pH=4.6 100h at 25°C	0
Climactic Resistance CR Water Vapor at 40-50°C for 30 h	1

Physical Properties	
Density, $\rho$ ( $\text{g}/\text{cm}^3$ )	2.74
Thermal Conductivity (25°C), $K$ ( $\text{W}/\text{m} \cdot \text{K}$ )	0.67
Young's Modulus, $E$ (GPa)	61.2
Poisson's Ratio, $\nu$	0.24
Fracture Toughness, $K_{Ic}$ ( $\text{MPa} \cdot \text{m}^{1/2}$ )	0.54
Knoop Hardness, $\text{HK}_{0.1/20}$	380
Heat Capacity (25°C), $C_p$ ( $\text{J}/\text{g} \cdot \text{K}$ )	0.78
Thermal Diffusivity (25°C), $\sigma$ ( $10^{-7} \text{ m}^2/\text{sec}$ )	3.2
Thermal Expansion, $\alpha_{20-300^\circ\text{C}}$ ( $10^{-7}/\text{K}$ )	112
Thermal Expansion, $\alpha_{20-40^\circ\text{C}}$ ( $10^{-7}/\text{K}$ )	93
Glass Transformation Temperature, $T_g$ (°C)	474

- Properties will vary slightly with doping content

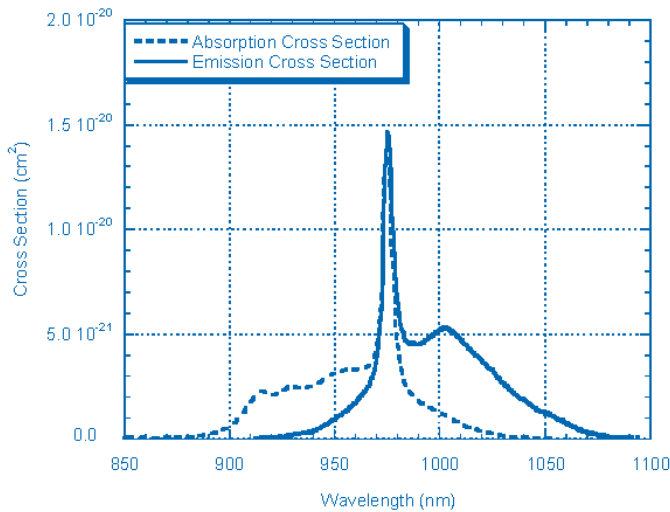
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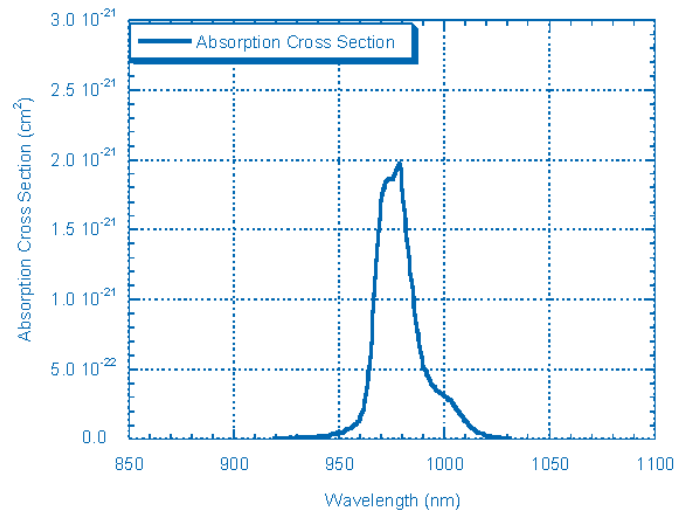


Erbium Absorption and Emission Cross Sections around 1540nm

Ytterbium Absorption and Emission Cross Sections around 980nm



Erbium Absorption Cross Section around 980nm



For more information please contact:

Advanced Optics  
**SCHOTT AG**  
Hattenbergstrasse 10  
55122 Mainz  
Germany

Phone: +49 (0)6131/66-1812  
Fax: +49 (0)3641/2888-9047  
info.optics@schott.com  
www.schott.com/advanced\_optics

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