

Nd:KGW - Neodymium Doped Potassium Gadolinium Tungstate ($\text{Nd:KGd}(\text{WO}_4)_2$)

Introduction

Neodymium doped Potassium Gadolinium Tungstate ($\text{Nd:KGd}(\text{WO}_4)_2$ or Nd:KGW) is an excellent laser gain material which has low laser oscillations threshold and high emission section. The fluorescent concentration quench effect of the Nd^{3+} ion in the KGW crystal may be weakened due to the W-O covalent bond, so this crystal has a higher doping concentration of active ion. Furthermore, the absorption band at 808 nm of Nd^{3+} in the KGW which has 12 nm FWHM is well matched with the emission wavelength of current commercial laser diode.

Table 1. Basic Properties

Crystal Structure	monoclinic
Space Group	$C_{2h}(2/c) - C2/c$
Lattice Parameter	$a = 8.087 \text{ \AA}$, $b = 10.374 \text{ \AA}$, $c = 7.588 \text{ \AA}$ $\beta = 94.41^\circ$
Refractive Index, at 1067 nm	$n_g = 2.049$, $n_p = 1.978$, $n_m = 2.014$
Mohs Hardness	5 Mohs
Density	7.27 g/cm^3
Melting Point	1075°C
Thermal Conductivity at 373 K	$K_{[100]} = 2.6 \text{ W/m/K}$ $K_{[010]} = 3.8 \text{ W/m/K}$ $K_{[001]} = 3.4 \text{ W/m/K}$
Young's Modulus	$E_{[100]} = 115.8 \text{ Gpa}$, $E_{[010]} = 152.5 \text{ GPa}$, $E_{[001]} = 92.4 \text{ Gpa}$
Thermal Expansion Coefficient, at 373°C	$\alpha_{[100]} = 4 \times 10^{-6}/\text{K}$, $\alpha_{[010]} = 1.6 \times 10^{-6}/\text{K}$, $\alpha_{[001]} = 8.5 \times 10^{-6}/\text{K}$
Lasing Wavelength	911 nm, 1067 nm, 1351 nm
Absorption Band	808 nm (FWHM 12 nm)
Fluorescent Lifetime	110 μs (3% doping), 90 μs (8% doping)

Table 2. Laser Properties

3% Nd:KGW	Emission Wavelength	1070 nm
	Emission Bandwidth	15 nm
	Stimulated Emission Cross-section σ_e	$1.48 \times 10^{-20} \text{ cm}^2$
	Fluorescent Lifetime	109 μs
	Gain Bandwidth	15 nm
	Absorption Wavelength	810 nm
	Absorption Bandwidth	14 nm
	Absorption Cross-section σ_a	$1.28 \times 10^{-20} \text{ cm}^2$

Specifications of Nd:KGW crystal from CASTECH

Table 3. Specifications of Nd:KGW

Orientation	[010]
Standard Dopant Concentration	Nd: 3, 5, 8 at.%
Maximum Length	50 mm
Dimensional Tolerances	Diameter: ± 0.1 mm Length: ± 0.5 mm
Surface Quality (Scratch/Dig)	20/10 to MIL-PRF-13830B
Flatness	$\lambda/6$ @633 nm
Parallelism	20 arc sec
Perpendicularity	≤ 15 arc min
Coating	AR-coated

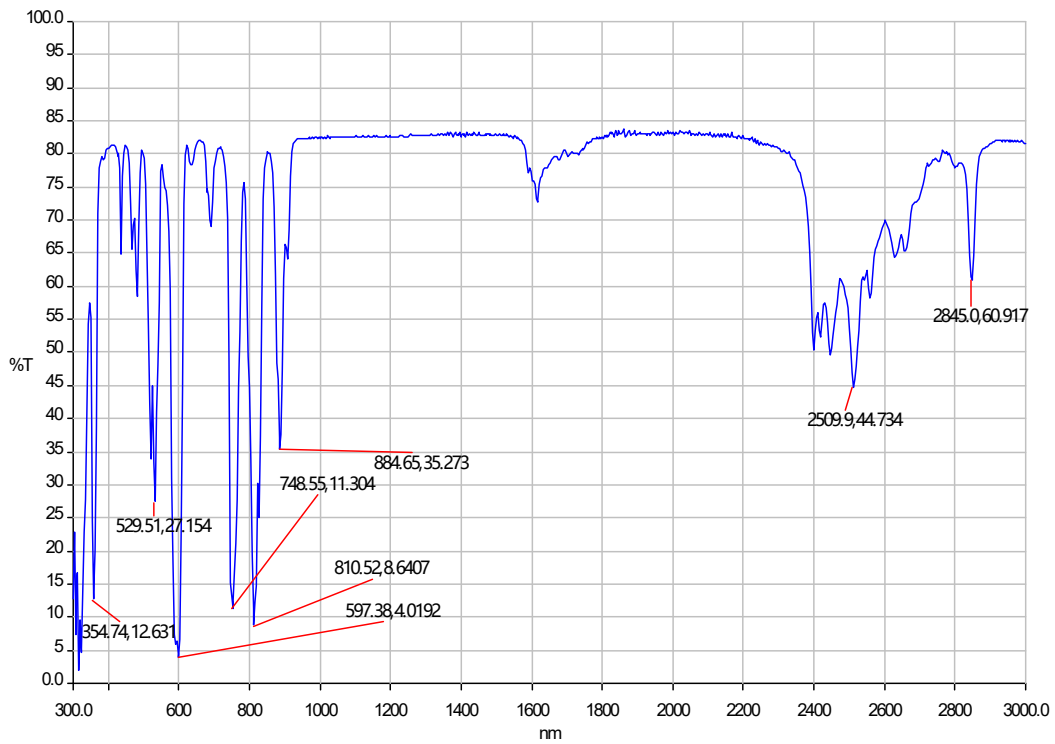


Figure 1. Transparency curve of Nd:KGW

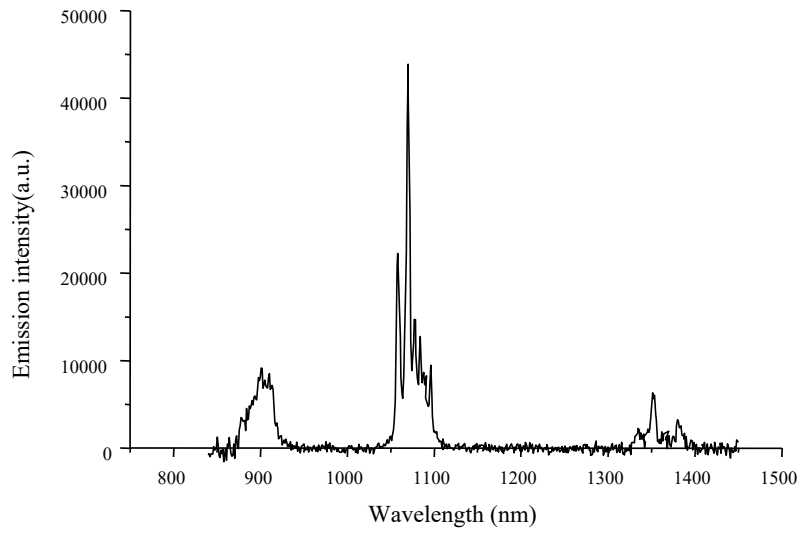


Figure 2. Emission spectra of 3% Nd:KGW

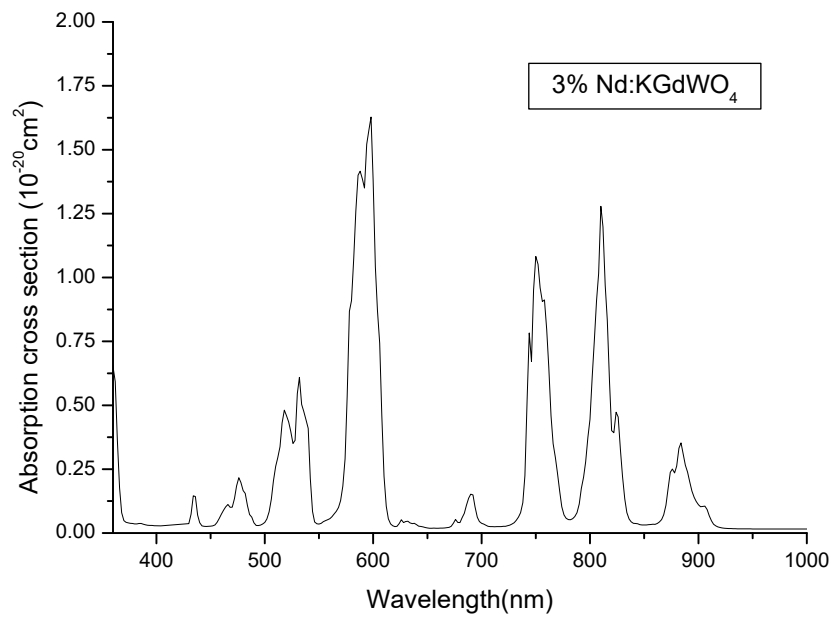


Figure 3. Absorption spectra of 3% Nd:KGW