V3+:YAG as saturable absorber for near infrared lasers

V. Mikhailov, N. Zhavoronkov, N. Kuleshov, V. Sandulenko, K. Yumashev, P. Prokoshin

► To cite this version:

V. Mikhailov, N. Zhavoronkov, N. Kuleshov, V. Sandulenko, K. Yumashev, et al.. V3+:YAG as saturable absorber for near infrared lasers. Journal de Physique IV Proceedings, 1994, 04 (C4), pp.C4-606-C4-606. 10.1051/jp4:19944156 . jpa-00252612

HAL Id: jpa-00252612

<https://hal.science/jpa-00252612>

Submitted on 1 Jan 1994

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

V³⁺:YAG as saturable absorber for near infrared lasers

V.P. MIKHAILOV, N.I. ZHAVORONKOV, N.V. KULESHOV, V.A. SANDULENKO,
K.V. YUMASHEV and P.V. PROKOSHIN

International Laser Center, Belarusian State University, Kurchatov Str. 7, Minsk 220064, Belarus

Saturation of near infrared absorption was investigated recently in tetravalent chromium doped garnets and forsterite [1]. These systems were shown to be effective solid state saturable absorbers for neodymium lasers. In this paper we report on vanadium doped YAG as a new solid state passive shutter for near infrared laser systems.

Tetrahedral V³⁺ ion has a 3d² electron configuration and is characterized by the two strong broad absorption bands in the near infrared with peaks at 1.3 μm and 0.83 μm . These bands are assigned to transitions from the ³A₂ ground state to the excited states ³T₂ and ³T₁, respectively. Saturation of absorption was observed for both these transitions. The saturation energy density of $24 \pm 7 \text{ J/cm}^2$ was estimated at 1.08 μm .

An upper limit for intra ³T₂ state vibrational relaxation time of $10 \pm 5 \text{ ps}$ and absorption recovery time of about $5 \pm 2 \text{ ns}$ were estimated from picosecond pump-and-probe relaxation measurements.

Mode-locked and Q-switched laser operations were obtained using V³⁺:YAG as a saturable absorber for Ti-Al₂O₃ laser at 770 nm and Pr-YAlO₃ laser at 747 nm. The ³A₂ - ³T₁ transition of absorber was excited by the emission of these lasers. Ultrashort pulses observed were 0.3 - 0.5 ns in duration and 0.5 mJ in energy for both these lasers. Q-switched pulses with energy up to 5 mJ were 50 - 80 ns in duration for Pr-YAlO₃ and approximately 300 ns for Ti-Al₂O₃ laser.

Mode-locked laser operation was realized also for 1.34 μm Nd-YAlO₃ and 1.06 μm Nd-YAG lasers. The train of ultrashort pulses with total energy of about 8 mJ was observed at 30 J pump energy for Nd-YAlO₃ laser. Single pulses were 0.1 - 0.3 ns in duration.

1. M.I.Demchuk, V.P.Mikhailov, N.I.Zhavoronkov, N.V.Kuleshov, P.V.Prokoshin, K.V.Yumashev, M.G.Livshits, and B.I.Minkov. Opt. Lett. 17, No. 13 (1992).