

# Z-scan technique to study gain properties of optically pumped media

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## Abstract

© 2018 Astro Ltd. The opportunity to study the optical gain properties of active media using the open aperture z-scan technique without an additional probe beam is demonstrated. The method allows for the evaluation of pump-induced photodynamic process parameters in UV solid-state active media on pumping and lasing wavelengths: excited-state absorption and photoionization cross-sections of active ions, effective absorption and ionization cross-sections of color centers and recombination rates.

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## Keywords

active media, amplified spontaneous emission, optical gain, z-scan

## References

- [1] Koechner W 2006 Solid-State Laser Engineering (New York: Springer)
- [2] Denker B and Shklovsky E (ed) 2013 Handbook of Solid-State Lasers. Materials, Systems and Applications (Woodhead Publishing Series in Electronic and Optical Materials vol 35) (Cambridge: Woodhead)
- [3] Silfvast W T 2004 Laser Fundamentals (Cambridge: Cambridge University Press)
- [4] Semashko V V 2005 Phys. Solid State 47 1507-11
- [5] Hamilton D S 1985 Trivalent cerium doped crystals as tunable system. Two bad apples Tunable Solid-State Lasers ed P Hammerling et al (Berlin: Springer) pp 80-90
- [6] Jander P, Sahu J K and Clarkson W A 2004 High-power Er:YAG laser at 1646 nm pumped by an Er,Yb fiber laser Proc. SPIE 5620 297-307
- [7] Sorokin E 2004 Solid-state materials for few-cycle pulse generation and amplification Few-Cycle Laser Pulse Generation and Its Applications (Topics Applied Physics vol 95) ed F X Kärtner (Berlin: Springer) pp 3-73
- [8] Allen L and Peters G I 1973 Phys. Rev. A 8 2031-47
- [9] Silfvast W T and Deech J S 1967 Appl. Phys. Lett. 11 97
- [10] Marowsky G, Tittel F K, Wilson W L and Frenkel E 1980 Appl. Opt. 19 138-43
- [11] Smith P W, Liao P F, Shank CV, Lin C and Maloney P J 1975 IEEE J. Quantum Electron. QE-11 84-9
- [12] Shank C V 1975 Rev. Mod. Phys. 47 649-57
- [13] Shaklee K L, Nahory R E and Leheny R F 1973 J. Lumin. 7 284-309
- [14] Pazzi G P, Baldecchi M G, Fabeni P, Linari R, Ranfagni A, Cetica M and Simkin D J 1982 Opt. Commun. 43 405-8
- [15] Semashko V V, Abdulsabirov R Yu, Korableva S L, Naumov A K, Galjautdinov B M, Cefalas A C, Kollia Z and Sarantopoulou E 1997 Proc. SPIE 3239 240-5
- [16] Van Stryland E W and Sheik-Bahae M 1998 Z-scan measurements of optical nonlinearities Characterization Techniques and Tabulations for Organic Nonlinear Materials ed M G Kuzyk and C W Dirk (Marcel: Dekker Inc) pp 655-92
- [17] Oliveira L C, Catunda T and Zilio S C 1996 Japan. J. Appl. Phys. 35 2649-52

- [18] Hai L H, Hung N D, Diwa G, Quema A, Marukami H, Ono S and Sarukura N 2005 Japan. J. Appl. Phys. 44 7984-6
- [19] Galiev A, Semashko V, Akhtyamov O, Shnaidman S, Marisov M, Nizamutdinov A and Shavelev A 2013 J. Phys: Conf. Ser. 478 012024
- [20] Nizamutdinov A S, Semashko V V, Naumov A K, Korableva S L, Marisov M A, Efimov V N and Nurtdinova L A 2001 Proc. SPIE 7994 79940H1
- [21] Guliano C R and Hess L D 1967 IEEE J. Quantum Electron. QE-3 358-67
- [22] Bondar M V, Przhonska O V and Tikhonov Y A 1992 J. Phys. Chem. 96 10831-7
- [23] Perry J W, Alvarez D, Choong I, Mansour K, Marder S R and Perry K J 1994 Opt. Lett. 19 625-7
- [24] Pritchett T 2002 Models for Saturable and Reverse Saturable Absorption in Materials for Optical Limiting (Adelphi, MD: Army Research Lab)
- [25] Dubinskii M A, Semashko V V, Naumov A K, Abdulsabirov R Yu and Korableva S L 1993 Laser Phys. 3 216-7
- [26] Dubinskii M A, Semashko V V, Naumov A K, Abdulsabirov R Yu and Korableva S L 1993 J. Mod. Opt. 40 1-5
- [27] Marshall C D, Speth J A, Payne S A, Krupke W F, Quarles G J, Castillo V and Chai B H T 1994 J. Opt. Soc. Am. B 11 2054-65
- [28] Sarukura N et al 1995 IEEE J. Sel. Top. Quantum Electron. 1 792-804
- [29] McGonigle A J S, Coutts D W and Webb C E 1999 Opt. Lett. 24 232-4
- [30] Alderighi D, Toci G, Vannini M, Parisi D, Bigotta S and Tonelli M 2006 Appl. Phys. B 83 51-4
- [31] Sarukura N, Liu Z, Ohtake H, Segawa Y, Dubinskii M A, Semashko V V, Naumov A K, Korableva S L and Abdulsabirov R Yu 1997 Opt. Lett. 22 994-6
- [32] Sarukura N, Liu Z, Segawa Y, Semashko V V, Naumov A K, Korableva S L, Abdulsabirov R Yu and Dubinskii M A 1995 J. Appl. Phys. Lett. 67 602-4
- [33] Galiev A I, Semashko V V, Akhtyamov O R, Shnaidman S A, Marisov M A and Shavelev A A 2014 J. Phys.: Conf. Ser. 560 012014
- [34] Svelto O 2010 Principles of Lasers 5th edn (Heidelberg: Springer)
- [35] Kazakov B N, Korableva S L, Semashko V V, Goriev O G and Khadiev A R 2017 J. Lumin. 187 410-4
- [36] Dubinskii M A, Semashko V V, Naumov A K, Abdulsabirov R Yu and Korableva S L 1994 (OSA Proc. on Adv. Solid-State Lasers vol 20) ed T Fan and B Chai (Washington, DC: Optical Society of America) pp 222-6
- [37] Semashko V V, Dubinskii M A, Abdulsabirov R Yu, Naumov A K, Korableva S L, Sherbakova N K and Klimovitskii A E 1995 Laser Phys. 5 69-72
- [38] Abdulsabirov R Yu, Dubinskii M A, Korableva S L, Naumov A K, Semashko V V, Stepanov V G and Zhuchkov M S 2001 J. Lumin. 94-5 113-7
- [39] Bogdanovich M V, Grigor'ev A V, Kabanov V V, Lebiadok Y V, Ryabtsev G I, Ryabtsev A G, Shchemelev M A, Dementjev A S, Agrawal L and Bhardwaj A 2010 Lith. J. Phys. 50 413-8