276
11-19-69

632

IN-1262
December 1968

MASTER

BIBLIOGRAPHY OF LASER PUBLICATIONS OF
INTEREST TO EMISSION SPECTROSCOPISTS

II

IDAHO NUCLEAR CORPORATION
NATIONAL REACTOR TESTING STATION
IDAHO FALLS, IDAHO

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

U. S. ATOMIC ENERGY COMMISSION

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Printed in the United States of America
Available from
Clearinghouse for Federal Scientific and Technical Information
National Bureau of Standards, U. S. Department of Commerce
Springfield, Virginia 22151
Price: Printed Copy \$3.00; Microfiche \$0.65

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

IN-1262
Issued: December 1968
Chemistry
TID-4500

BIBLIOGRAPHY OF LASER PUBLICATIONS OF
INTEREST TO EMISSION SPECTROSCOPISTS

II.

Edited by

Jon M. Baldwin

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:
A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or
B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.
As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

IDAHO NUCLEAR CORPORATION

A JOINTLY OWNED SUBSIDIARY OF
AEROJET ALLIED
GENERAL CHEMICAL
CORPORATION CORPORATION

U. S. Atomic Energy Commission Research and Development Report
Issued Under Contract AT(10-1)-1230
Idaho Operations Office

REPRODUCTION OF THIS DOCUMENT IS UNLIMITED

fly

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

INTRODUCTION

	<u>Page</u>
I. INTRODUCTION.	1
II. LIST OF REFERENCES.	2
1. Laser Beam Interactions With Gases.	2
2. Laser Beam Interactions With Condensed Phases . . .	6
3. Laser Applications To Spectrographic Analysis . .	12

BIBLIOGRAPHY OF LASER PUBLICATIONS OF INTEREST TO EMISSION SPECTROSCOPISTS

I. INTRODUCTION

This report is a continuation of the literature coverage begun in IN-1219, "Bibliography of Laser Publications of Interest to Emission Spectroscopists." The literature search is brought up to December 1, 1968. A number of publications prior to the terminal date of the previous Bibliography have been discovered and are also included in this report.

II. LIST OF REFERENCES

1. Laser Beam Interactions With Gases

1. Abrikosova, I., and M. Shcherbina - Samailova, Measurement of the Threshold Parameters for the Breakdown of Liquid and Gaseous Helium by a Laser Beam, JETP Lett., 1, 239 (1968).
2. Adelman, A., Laser-induced Breakdown of Organic Vapors, J. Chem. Phys., 45, 3152 (1966).
3. Askar'yan, G., M. Rabinovich, M. Savchenko and V. Stepanov, "Fire Ball" of Light Breakdown in the Laser Beam Focal Point, Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5, 150 (1967).
4. Barynin, A., and R. Khokhlov, Mechanism of Light Breakdown in a Gas, Zh. Eksp. Teor. Fiz., 50, 372 (1966).
5. Bergqvist, T., and B. Kleman, Breakdown in Gases by 10,600 A Laser Radiation, Arkiv Fysik, 31, 177 (1966).
6. Berry, M., Theoretical Investigation of the Transmission of Strong Light Intensities in a Gas, C. R. Acad. Sci., Paris, Ser. A, B, 262, 1395 (1966).
7. Breton, C., M. Capet, V. Chalmeton, D. Quang and R. Papoular, Effects of Focusing an Intense Luminous Beam in a Gas, J. Phys. (Paris), 26, 490 (1965).
8. Chalmeton, V., and R. Papoular, Mechanism of Breakdown of Gases by Laser, C. R. Acad. Sci., Paris, Ser. A, B, 262, 177 (1966).
9. Chalmeton, V., and R. Papoular, Light Emission by a Gas Under the Effect of an Intense Laser Radiation, C. R. Acad. Sci., Paris, Ser. A, B, 264, 213 (1967).
10. Damon, E., and R. Tomlinson, Ionization of Gases by Optical Maser Radiation, Rept. 1083-19 (1962).
11. Evans, L., and C. Morgan, Multiple Collinear Laser-Produced Sparks in Gases, Nature, 219, 712 (1968).
12. Evtushenko, T., A. Zaidel, G. Ostrovskaya and T. Chelidze, Spectroscopic Investigations of a Laser Spark. I. Spark in Helium., Zh. Tekh. Fiz., 36, 1506 (1966).
13. Gardner, J., Statistical Models for Laser-induced Ionization of Gases, Electron. Lett., 2, 297 (1966).

14. Gardner, J., Photon Correlations in Ionizing Laser Beams, Electron. Lett., 2, 397 (1966).
15. Gardner, J., The Role of Photon Statistics in Laser Sparks, Int. J. Electron., 21, 479 (1966).
16. Grutman, M., R. Minikaeva, V. Mitsuk and V. Chernikov, Optical Breakdown of Mercury Vapor, JETP Lett., 7, 243 (1968).
17. Hantzsche, E., R. Rompe and H. Wolff, Ionization of Gases by a Laser Beam, Montsber. Deut. Akad. Wiss. Berlin, 8, 111 (1966).
18. Hora, H., Absorption Coefficient of Ruby Laser Radiation in Fully Ionized Light Elements, IPP-6/27 (1964).
19. Hora, H., Estimation of Heating of a Plasma by Lasers, TT-1193 (1964).
20. Komissarova, I., G. Ostrovskaya and T. Chelidze, Spectroscopic Investigations of the Laser Spark. II. An Apparatus with Time Splitting, Zh. Prikl. Spektrosk., 6, 557 (1967).
21. Lampis, G., and S. Brown, Afterglow Measurement of a Laser Breakdown Plasma, Phys. Fluids, 11, 1137 (1968).
22. Mandel'shtam, S., P. Pashinin, A. Prokhorov, Yu. Raizer and N. Sukhodrev, Air "Sparks" Caused by Focused Laser Beams, Beitr. Plasma Phys., 6, 1 (1966).
23. Mandel'shtam, S., P. Pashinin, A. Prokhorov and N. Sukhodrev, Optical Frequency Electrical Discharge in Air, Phys. Quantum Electron., 1965, 548.
24. Mink, R., and W. Rado, Optical Frequency Breakdown Phenomena, Phys. Quantum Electron., 1965, 527.
25. Mitsuk, V., V. Savoskin and V. Chernikov, Breakdown at Optical Frequencies in the Presence of Diffusion Losses, Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 4, 129 (1966).
26. Olness, D., Laser-induced Breakdown in Transparent Dielectrics, J. Appl. Phys., 39, 6 (1968).
27. Phelps, A., Theory of Growth of Ionization During Laser Breakdown, Phys. Quantum Electron., 1965, 397.
28. Rachman, A., and L. Bassani, Radiative Equilibrium Theory of Breakdown of Noble Gases by Laser Action, Phys. Lett., 25A, 772 (1967).

29. Rizzo, J., and R. Klewe, Optical Breakdown in Metal Vapors, Brit. J. Appl. Phys., 17, 1137 (1966).
30. Romanov, G., and K. Stepanov, Breakdown of Inert Gases, Zh. Prikl. Spectrosc., 6, 719 (1967).
31. Shaparev, N., Multiphoton Ionization of the Hydrogen Atom, Opt. Spectrosc., 23, 96 (1967).
32. Smith, D., and A. Haught, Investigation of the Mechanisms Associated with Gas Breakdown Under Intense Optical Illumination, AD-665000 (1967).
33. Smith, D., and R. Tomlinson, Effect of Mode Beating in Laser-Produced Gas Breakdown, Appl. Phys. Lett., 11, 73 (1967).
34. Tomlinson, R., Characteristics of Visible Discharges Induced in Gases by Focused Ruby Laser Pulses, Thesis, Ohio State University, 1965.
35. Tomlinson, R., Temporal Dependence in Laser-induced Gas Discharge, AD-460460 (1965).
36. Tomlinson, R., and E. Damon, Experimental Data on the Breakdown of Air and Argon by a Ruby Laser Pulse, AD-443784 (1964).
37. Tomlinson, R., E. Damon and H. Buscher, Breakdown of Argon by Neodymium and Ruby Laser Pulses, AD-460459, (1965).
38. Tomlinson, R., E. Damon and H. Buscher, The Breakdown of Noble and Atmospheric Gases by Ruby and Neodymium Laser Pulses, Phys. Quantum Electron., 1965, 520.
39. Vanyukov, M., V. Isaenko, V. Lyubimov, V. Serebryakov and A. Shorokhov, Use of a Laser Operating Under Pitch Conditions, to Produce a High Temperature Plasma. Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 3, 316 (1966).
40. Vanyukov, M., V. Venchikov, V. Isaenko, P. Pashinin and A. Prokhorov, Production of a High Temperature Dense Plasma by Gas Breakdown with the Aid of a Laser, JETP Lett., 7, 251 (1968).
41. Voronov, G., G. Delone and N. Delone, Multiphoton Ionization of Krypton and Argon by a Ruby Laser Beam, Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 3, 480 (1966).
42. Wiggins, T., R. Wick, D. Rank and A. Guenther, Laser-induced Breakdown in Oxygen Gas at High Pressure, Appl. Opt., 5, 166 (1966).

43. Yamanaka, C., M. Yokoyama, S. Nakai, T. Yamanaka and Y. Izawa, Interaction of the Laser Beam with Gaseous Matters, Technol. Rept. Osaka Univ., 16; 233 (1965).
44. Yasojima, Y., K. Kawabe and Y. Inuishi, Theory of Mechanism of Ionization and Breakdown in Gases by Intense Laser Pulse, Technol. Rept. Osaka Univ., 17, 399 (1967).
45. Young, M., S. Chin and N. Isenor, Laser-Induced Breakdown Freon-doped Rare Gas, Can. J. Phys., 46, 1537 (1968).

2. Laser Beam Interactions With Condensed Phases

1. Adams, M., and S. Tong, Laser-Microscope System as a Microsampling Device, Anal. Chem., 40, 1762 (1968).
2. Akhmanova, M., V. Kaigorodov and A. Karyakin, Infrared Spectroscopic Study of Condensed Products of a Plasma Produced by a laser, Zh. Prikl. Spektrosk., 8, 858 (1968).
3. Andreev, S., Yu. Dymshits, L. Kaporskii and G. Musatova, Thermo-electron Emission and Divergence of a Plasma Produced Under the Action of Focused Laser Single-Pulse Radiation on a Solid Target, Zh. Tekh. Fiz., 38, 875 (1968).
4. Anisimov, S., Evaporation of a Metal Absorbing Laser Radiation, Zh. Eksp. Teor. Fiz., 54, 339 (1968).
5. Askar'yan, G., Self-Isolation of Surface of a Body in a Medium Against Intense Light Flux. Induced Mirage, JETP Lett., 8, 10 (1968).
6. Aver'yanova, T., L. Mirkin, N. Pilipetskii and A. Rustamov, Influence of Intense Light Beams on a Metal Surface, Zh. Prikl. Mekh. Tekh. Fiz., 1965, 84.
7. Ban, B., S. Leach, G. Taieb and M. Velghe, Spectroscopic Study of Molecular Emission Excited by Laser Irradiation of Some Elements in the Solid State, J. Chim. Phys., 64, 397 (1967).
8. Basov, N., V. Boiko, Yu. Voinov, E. Kononov, O. Krokhin, S. Mandel'shtam and G. Sklizkov, Laser Spark-as an Excitation Source for Spectra of Highly Ionized Atoms, Rev. Roum. Phys., 13 97 (1968).
9. Belyanin, V., A. Zhukov, A. Kokora and A. Tusheva, Structure and Hardness of Steel Surface Layer after Laser Beam Treatment, Fiz. Khim. Obrab. Mater., 1967, 115.
10. Bernal, E., J. Ready and L. Levine, Ion Emission From Laser-irradiated Tungsten, AED-Conf-66-078-7 (1966).
11. Bobin, J., J. Buges, P. Langer and G. Tonon, Electron Density Profile in a Laser Produced Beryllium Plasma, C. R. Acad. Sci., Paris, Ser. A, B, 265, 1400 (1967).
12. Bonch-Bruevich, A., Ya. Imas, G. Romanov, M. Libenson and L. Mal'tsev, Variation of the Selectivity of Metals Under the Action of a Pulsed Laser, Zh. Tekh. Fiz., 38, 851 (1968).

13. Bonch-Bruevich, A., V. Kovalev, G. Romanov, Ya. Imas and M. Libenson, Variation in Reflectivity of Some Semiconductors Excited by Laser Light, *Sov. Phys.-Tech. Phys.*, 13, 507 (1968).
14. Bourrabier, C., T. Consoli and L. Slama, Intense Pulsed Sources of Ions and Electrons Produced by a Laser, *Phys. Lett.*, 23, 236 (1966).
15. Braerman, W., Use of a Langmuir Probe for Electron Temperature Determination in a Laser-induced Plasma, AD-631517 (1965).
16. Braginskii, V., I. Minakova and V. Rudenko, Some Mechanical Effects During the Interaction of the Pulsed Electromagnetic Radiation with Metals, *Zh. Tekh. Fiz.*, 37, 1045 (1967).
17. Bykovskii, Yu., V. Dorofeev, V. Dymovich, B. Nikolaev, S. Ryzhikh and S. Sil'nov, Mass Spectrometric Investigation of Ions Produced by the Interaction of Laser Radiation with a Material, *Zh. Tekh. Fiz.*, 38, 1194 (1968).
18. Caruso, A., and R. Gratton, Some Properties of the Plasmas Produced by Irradiating Light Solids by Laser Pulses, *Plasma Phys.*, 10, 867 (1968).
19. DeMichelis, C., and S. Ramsden, Plasma Production by Laser Beam Irradiation of a Single Solid Particle, *Phys. Lett.*, 25A, 162 (1967).
20. Dumas, J., Mass Spectrometer Ion Source, *Meth. Phys. Anal.*, 3, 47 (1967).
21. El-Kareh, A., and E. Reyner, Laser-induced Electron Emission, *Proc. Electron Beam Symp., Ann. Meeting, 6th, Boston, 1964*, 84.
22. Eloy, J., New Experiments with a Laser-Source Mass Spectrometer, *Meth. Phys. Anal.*, 4, 161 (1968).
23. Eloy, J., and J. Dumas, Ions Produced by Laser Impact in a Mass Spectrometer Source, *Meth. Phys. Anal.*, 2, 251 (1966).
24. Engelhardt, A., Plasma Production by a High-Power Q-Switched Laser. *Quart. Prog. Rept. No. 1, Feb. 1-April. 30, 1968, WERL-3472-10, (May 1, 1968)*.
25. Esteva, J., and J. Romand, Comparison Between Spectra Emitted in the Far Ultraviolet by Plasmas Produced by Focusing a Laser Beam on a Solid Target and by Sparks in a Vacuum, *C. R. Acad. Sci., Paris, Ser. A, B*, 264, 142 (1967).
26. Farkas, G., I. Kertesz, Z. Naray and P. Varga, On the Intensity Dependence of the Non-Linear Electron Emission from Silver Induced by a High Power Laser Beam, *Phys. Lett.*, 24A, 475 (1967).

27. Farkas, G., I. Kertesz, Z. Naray and P. Varga, The Laser-Induced Nonlinear Photoelectric Effect in Metals, Phys. Lett., 25A, 572 (1967).
28. Farkas, G., Z. Naray and P. Varga, Dependence of Nonclassical Electron Emission from Metals on the Direction of Polarization of Laser Beams, Phys. Lett., 24A, 134 (1967).
29. Fenner, N., and N. Daly, Instrument for Mass Analysis Using a Laser, J. Mater. Sci., 3, 259 (1968).
30. Foder, W., Hydrodynamic Model of a Spherical Plasma Produced by Q-Spoiled Laser Irradiation of a Solid Particle, Phys. Fluids, 11, 2200 (1968).
31. Gauthier, R., D. Bois, P. Pinard and F. Davoine, Production of Ions and Electrons by the Interaction of a Coherent Light Beam with Matter, Phys. Status Solidi, 25, 691 (1968).
32. Gibson, A., T. Hughes, M. Kimmitt and R. Hallin, Plasmas Produced by Focused CO₂ Laser Radiation, Phys. Lett., 27A, 470 (1968).
33. Gitlevich, A., Yu. Goloshchapov, V. Gorynin, T. Lange and Yu. Marsimov, Effect of Laser Radiation on Semiconductors, Fiz. Khim. Obrab. Mater., 1968, 120.
34. Grevtsev, N., N. Makarov, A. Skripnichenko and A. Uglov, Effect of Impulse Duration of Laser Radiation on the Depth of Metal Fusion, Fiz. Khim. Obrab. Mater., 1967, 116.
35. Harris, T., High Speed Photographs of Laser Induced Heating, IBM J. Res. Develop., 7, 342 (1963).
36. Howe, J. and T. Molloy, Graphite Jet Velocity by a Probe Method, J. Appl. Phys., 35, 2265 (1965).
37. Izawa, T., T. Yamanaka, N. Tsuchimori, M. Onishi and C. Yamanaka, Density Measurements of the Laser Produced Plasma by Laser Light Scattering, Japan. J. Appl. Phys., 7, 954 (1968).
38. Karn, F., R. Friedel and A. Sharkey, Distribution of Gaseous Products from Laser Pyrolysis of Coals of Various Ranks, Carbon (Oxford), 5, 25 (1967).
39. Karn, F., and A. Sharkey, Pyrolysis of Coal Macerals by Laser Irradiation, Fuel (London), 47, 193 (1968).
40. Karn, F., and J. Singer, Photographic Study of Laser Irradiation of Coal and Graphite, Fuel (London), 47, 235 (1968).

41. Knecht, W., Laser-induced Spontaneous Electron Emission from Rear Side of Metal Foils, Appl. Phys. Lett., 8, 254 (1966).
42. Kokora, A., A. Zhukov, V. Shalashov, E. Lyumarov, M. Kalyanova and V. Belyanin, Treatment of Steel with a Laser Beam, Metalloved. Term. Obrab. Metal., 1966, 41.
43. Krasyuk, B., V. Maslov and T. Stepanova, Dissociation of Some AIIIVBV Semiconducting Compounds Induced by Light Pulses from a Laser, Dokl. Akad. Nauk SSSR, 175, 1320 (1967).
44. Krasyuk, B., and T. Stepanova, Electrification of the Crystals of AIIIBIV and AIIIBV Type Semiconducting Compounds after Laser Irradiation, Dokl. Akad. Nauk SSSR, 176, 365 (1967).
45. Krasyuk, B., M. Voshchinskii and N. Zhukov, Chemical Interaction of a Metal with the Surrounding Medium During Erosion Treatment by Light, Fiz. Osn. Elekt. Obrab. Mater. Akad. Nauk SSSR, 1966, 148.
46. Krishtal, M., V. Koravchev and A. Kokora, Distribution of Carbon in Iron Alloy Zones Affected by Laser Radiation, Termodin, Fiz. Kinet. Strukturoobrazov. Stali Chugune, 1967, 285.
47. Kuepper, F., Plasma Production and Heating by Laser Radiation, NP-17453 (1968).
48. Lazeeva, G., A. Petrov and G. Skvortsova, The Possible Application of Lasers for Spectral-isotopic Determination of Gases in Metals, Vestn. Leningrad. Univ., Fiz. Khim., 22, 63 (1967).
49. Levine, L., J. Ready and E. Bernal, Gas Desorption Produced by Giant Pulse Laser, J. Appl. Phys., 38, 331 (1967).
50. Mace., P., Design and Use of a High Power Laser for Plasma Generation Studies, LA-3369 (1965).
51. Megrue, G., Isotopic Analysis of Rare Gases with a Laser Microprobe, Science, 157, 1555 (1967).
52. Millar, W., Calculated Evaporation Rates for Liquid and Solid Hydrogen with Application to Laser-produced Plasmas, CLM-M-74, (1968).
53. Mirkin, L., and N. Pilipetskii, Hardening of Hard Alloy Under the Action of Light Rays, Izv. Akad. Nauk. SSSR, Metal., 1967, 137.
54. Mirkin, L., and N. Pilipetskii, The Physical Nature of Steel Hardening Under Light Impulses, Dokl. Akad. Nauk SSSR, 172, 580 (1967).

55. Namba, S., P. Kim, T. Itoh, T. Arai and H. Schwartz, Ion Emission from Metal Surface Irradiated by Giant Pulse Laser Beam, Sci. Pap. Inst. Phys. Chem. Res. (Tokyo), 60, 101, (1966).
56. Namba, S., P. Kim, S. Nakayama and I. Ida, The Surface Temperature of Metals Heated with Laser, Rika Gaku Kenkyusho Hokoku, 41, 1 (1964).
57. Opower, H., and W. Press, Obtaining Energy-Rich Plasmas by Light Impulses, Z. Naturforsch., 21A, 344 (1966).
58. Paton, B., and N. Isenor, Energies and Quantities of Ions in Laser-Produced Metal Plasmas, Can. J. Phys., 46, 1237 (1968).
59. Penner, S., Evaporation Coefficients from Exposure of a Solid to Laser Radiation, AIAA J., 2, 1664 (1964).
60. Pittaway, L., J. Smith, E. Fletcher and B. Nichols, Laser-Induced Electron Emission from Tungsten, Tantalum and Lanthanum Hexaboride Using Ruby and Argon Lasers, Brit. J. Appl. Phys., Ser. 2, 1, 711 (1968).
61. Ready, J., Interaction of High Power Laser Radiation with Absorbing Surfaces, Proc. Nat. Electronics Conf., 20, 67 (1964).
62. Rosseau, D., G. Leroi and W. Falconer, Charged Particle Emission After Ruby Laser Irradiation of Transparent Dielectric Materials, AD-655105 (1967).
63. Rudenko, V., Momentum Transfer Produced by Laser Pulses, Vestn. Mosk. Univ., Ser. III, 1967, 115.
64. Ryvkin, S., V. Salmonov and I. Yaroshetskii, Thermal Radiation from Silicon Illuminated by a Laser Beam, Sov. Phys. - Solid State, 10, 807 (1968).
65. Schmidt, A., I. Ham and T. Hoshi, An Evaluation of Laser Performance in Microwelding, Weld. J., 44, 481-S (1965).
66. Sharkey, A., J. Shultz and R. Friedel, Gases from Flash and Laser Irradiation of Coal, Nature, 202, 988 (1964).
67. Sharkey, A., J. Shultz and R. Friedel, Comparison of Products from High-Temperature Irradiation and Carbonization of Coal, U. S. Bur. Mines Rept. Invest. No. 6868 (1966).
68. Sharkey, A., J. Shultz and R. Friedel, Gases from Flash and Laser Irradiation of Coal, Advan. Chem. Ser. No. 55, 643 (1966).

69. Shultz, J., and A. Sharkey, Gases from Laser Irradiation of Coal: Effect of Argon, Nitrogen and other Atmospheres, Carbon (Oxford), 5, 57 (1967).
70. Stumpfel, C., and F. Braerman, Effects of Power Density on Characteristics of Laser Beam Interaction with Solid Materials, AD-649732 (1967).
71. Sucov, E., J. Pack, A. Phelps and A. Engelhardt, High Temperature Plasmas by Laser Heating, TID-22928 (1966).
72. Veiko, V., and Ya. Imas, Disintegration of Ferrite Under Action of Laser Radiation, Fiz. Khim. Obrab. Mater., 1967, 120.
73. Verber C., and A. Adelman, The Interaction of Laser Beams with Metals, Battelle Tech. Rev., 14, 3 (1965).
74. Waniek, R., and P. Jarmuz, Acceleration of Microparticles by Laser-induced Vapor Emission, Appl. Phys. Lett., 12, 52 (1968).
75. Weichel, H., P. Avizonis and D. Vonderhaar, Plasma Ion Oscillations in a Laser-Produced Plasma, Phys. Rev. Lett. 19, 10 (1967).
76. Yura, H., The Interaction of Laser Light with Metals (Electron-Optical Phonon Interaction in Metals), AD-401478 (1963).
77. Zaidel, A., G. Ostrovskaya and Yu. Ostrovskii, Holographic Diagnosis of a Plasma, LA-tr-68-23 (1968).

3. Laser Applications to Spectrographic Analysis

1. Allemand, C., The Use of Lasers in Emission Spectroscopy, *Met. Ital.*, 56, 411 (1964).
2. Anon., Spectroscopic Analysis of Metals by Means of Laser Microprobe, *JEOL News*, 6M (1), 8 (1968).
3. Asprukh, P., Local Spectrum Analysis by Means of Optical Quantum Generators (Lasers), *Mashinostroene*, 16, 285 (1967).
4. Berndt, M., H. Krause, L. Moenke-Blankenburg and H. Moenke, Micro-Emission Spectrochemical Analysis with Solid-State Lasers, *Jenear Jahrb.*, 1965, 45.
5. Blackburn, W., Y. Pelletier and W. Dennen, Spectrochemical Determinations in Garnets Using a Laser Microprobe, *Appl. Spect.*, 22, 278 (1968).
6. Blankenburg, H., H. Moenke, L. Moenke-Blankenburg and K. Wehrberger, Application of Laser Microspectral Analysis and IR 10 Microapparatus in the Determination of Crystalline Inclusions in Rock Crystals, *Krist. Tech.*, 1, 351 (1966).
7. Cerrai, E., and R. Trucco, Some Experiments on the Application of Laser Sampling to Emission Spectroscopy; Determination of Elements, Effects of Material Structure, *Met. Ital.*, 59, 615 (1967).
8. Glick, D., The Laser Microprobe. Its Use for Elemental Analysis in Histochemistry, *J. Histochem. Cytochem.*, 14, 862 (1966).
9. Glick, D., and R. Rosan, Laser Microprobe for Elemental Microanalysis, *Microchem. J.*, 10, 393 (1966).
10. Karyakin, A., M. Akhmanova, and N. Popova, Use of a Laser for the Spectral Analysis of Semiconductor Materials, *Tr. Kom. Anal. Khim., Acad. Nauk SSSR, Inst. Geokhim. Anal. Khim.*, 16, 59 (1968).
11. Karyakin, A., M. Akhmanova, V. Kaigorodov and N. Popova, Use of a Laser for the Spectral Determination of Chromium in a Ruby, *Zavod. Lab.*, 33, 1094 (1967).
12. Karyakin, A., and V. Kaigordov, Time Studies of the Emission of Vapors During a Combined Excitation Process, *Zh. Prikl. Spektrosk.*, 8, 433 (1968).
13. Karyakin, A., and V. Kaigordov, The Use of an Impulse Laser in Atomic Absorption Spectrographic Analysis, *Zh. Anal. Khim.*, 23, 930 (1968).

14. Kasatkin, V., and K. Taganov, Laser Spectra in a Monoimpulse System for Analysis, Zh. Prikl. Spectrosk., 8, 223 (1968).
15. Katsuno, Y., H. Sunahara, K. Morita and T. Takeuchi, Laser Microprobe for Spectrochemical Analysis, Bunko Kenkyu, 16, 151 (1968).
16. Katsuno, Y., T. Takeuchi, H. Sunahara and K. Morita, Emission Spectral Analysis with Laser Excitation, Bunseki Kagaku, 17, 376 (1968).
17. Korunchikov, A., and A. Yankovskii, Some Peculiarities of the Evaporation of a Substance in a Plasma and of the Excitation of its Spectra under the Action of Laser Radiation, Zh. Prikl. Spectrosk., 5, 586 (1966).
18. Korunchikov, A., and A. Yankovskii, Sources Affecting the Nature of a Plasma Prepared by Means of a Laser, Zh. Prikl. Spektrosk., 7, 564 (1967).
19. Lithwick, N., M. Healy and J. Cohen, Microanalysis of Bone by Laser Microprobe, Surg. Forum, 15, 439 (1964).
20. Malissa, H., and H. Arlt, Discussion on "Comparative Observations on Electron Beam Microanalysis and Laser Micro Spectral Analysis", Microchim. Acta, Suppl. 2, 101 (1967).
21. Moenke, H., Comparative Observations on Electron Beam Microanalysis and Laser Micro Spectral Analysis, Microchim. Acta, Suppl. 2, 93 (1967).
22. Moenke, H., Comparative Observations of Electron Beam Microanalysis and Laser Micro Spectral Analysis. Reply., Microchim. Acta, Suppl. 2, 105 (1967).
23. Moenke, H., Progress in the Field of Laser Microspectral Analysis, Fortschr. Miner., 44, 173 (1967).
24. Moenke, H., Methodical Properties of Laser Micro-spectroscopy, Proc. Conf. Appl. Phys. - Chem. Methods Chem. Anal., Budapest, 3, 219 (1968).
25. Moenke, H., and L. Moenke-Blankenburg, Laser Microspectral Analysis, Jena Rev., 11, 166 (1966).
26. Moenke-Blankenburg, L., Spectral Emission Microanalysis with Solid State Lasers, Umschau Wiss. Tech., 66, 329 (1966).

27. Moenke-Blankenburg, L., Function and Application Possibility of the Laser Micro Spectral Analyzer LMA 1, *Microchim. Acta, Suppl.* 2, 82 (1967).
28. Moenke-Blankenburg, L., Laser Microspectral Analyzer LMA-1 From Jena, *Feingeraetetechnik*, 17, 193 (1968).
29. Moenke-Blankenburg, L., Fields of Application of Laser Microspectroscopy, *Proc. Conf. Appl. Phys. - Chem. Methods Chem. Anal.*, Budapest, 3, 227 (1968).
30. Moenke-Blankenburg, L., and H. Moenke, Laser-Microspectroanalyzer, a New Instrument for Analysis, *Glas-Instr.-Tech.*, 10, 85 (1966).
31. Putrenko, O., and A. Yankovskii, Increase in the Effective Utilization of a Substance During Spectrographic Analysis Using Lasers, *Zh. Prikl. Spektrosk.*, 8, 500 (1968).
32. Rosan, R., D. Glick and F. Brech, Progress in Laser Microprobe Emission Spectroscopy, *Fed. Proc.*, 24, 242 (1965).
33. Scribner, B., Advances in Excitation Sources for Spectrochemical Analysis, *Pure Appl. Chem.*, 10, 579 (1966).
34. Van Draät, H., Microanalysis with Lasers, *Chem. Tech. Rev.*, 22, 133 (1967).
35. Webb, M., and J. Cotterill, The Determination of Micro-concentration Gradients on the Surfaces of Solid Samples by Means of the Laser-Microprobe, *Anal. Chim. Acta*, 43, 351 (1968).
36. Zhukov, A., A. Karora, E. Nikiforova, V. Zhukova and L. Komysakov, Microsampling of Cast Iron with a Laser for Spectrographic Analysis, *Termodin. Fiz. Kinet. Ostrukturoobrazov. Stali Chuguna*, 1967, 291.
37. Zhukov, A., E. Nikiforova and A. Kokora, Combined Method for Local Spectrographic Analysis Using Lasers, *Zh. Prikl. Spektrosk.*, 6, 590 (1967).