

Second-Stage Enrichment in the Laser Separation of Carbon Isotopes

M. Gauthier, A. Outhouse, Y. Ishikawa, K. O. Kutschke, P. A. Hackett (Canada)

There is a general agreement that efficient infrared laser induced separation of carbon isotopes requires a two-stage process. An efficient first stage 1% → 50% ¹³C enrichment was shown by Gauthier et al. [1] to be feasible and competitive with conventional technology. In this work, second-stage CO₂ laser enrichment of equimolar mixtures of ¹²CHClF₂ and ¹³CHClF₂ has been demonstrated yielding tetrafluoroethylene containing 95% or 99% ¹³C. Forward enrichment by selective decomposition of the ¹³CHClF₂ fraction was very efficient, absorbing only 6 and 16 eV, respectively, per carbon atom produced at 95% and 99% ¹³C content.

Phase Coherent Effects in a Collisional Turbulent Plasma

J. A. Johnson III, R. Ramaiah (USA)

Stochastic fluctuations in a glow-discharge tube show typical turbulent spectra, mode-mode coupling, and evidence of pronounced three-dimensionality.

Xe₂Cl Fluorescence and Absorption in Self-Sustained Discharge XeCl Lasers

H. Shields, A. J. Alcock (Canada)

Fluorescence at 490nm for the triatomic excimer Xe₂Cl* has been investigated to determine the 308nm absorption due to this species in an x-ray preionized, self-sustained gas discharge XeCl laser. The dependence of Xe₂Cl* density on laser intensity (at 308nm), buffer gas and Xe and HCl partial pressures has been determined for discharges with a peak electrical power deposition of 2.5 GWl⁻¹. Xe₂Cl* absorption is estimated to reach 0.6%cm⁻¹ under non-lasing conditions but decreases to a non-saturable 0.2%cm⁻¹ for intracavity laser intensity > 1MW cm⁻². XeCl* and Xe₂Cl* fluorescence intensities were found to be similar for both helium and neon buffer gases but laser output was a factor of two greater with a neon buffer.

Electrode Design for a Magnetically Stabilized Glow Discharge

D. M. Antoniuk, H. J. J. Seguin, C. E. Capjack (Canada)

The operational characteristics of a magnetically stabilized glow discharge are investigated for several different experimental electrode configurations. In this parametric study, successive geometries were designed to accommodate and/or control specific aspects of the plasma glow process. In this manner, an electrode structure which optimizes discharge stability and promotes glow uniformity over an extended active volume, was ultimately achieved. The study teaches a promising new technique for significantly increasing the power density of high power gas lasers.

Experimental data is in excellent correlation with predictions provided by a previous numerical study of this magnetic stabilization process.

Resonant Generation of Even-Order Harmonics in Metal Vapors

V. A. Kiyashko, A. K. Popov, V. P. Timofeev, N. P. Makarov, V. Sh. Epstein (USSR)

Generation of the second- and fourth-order harmonics of laser radiation is reported in Mg vapor at the forbidden 3s²1S₀-4s¹3S₀ transition. The conversion efficiency for the second-order harmonics has been measured to be ~ 10⁻²% and for the fourth one ~ 10⁻⁸%.

Small-Signal Gain of a Free Electron Laser in a Resonator Gaussian Mode

I. Boscolo, J. Gallardo (USA)

We present an analytical expression for the small-signal gain of a Free Electron Laser (FEL) in the presence of a Gaussian mode. To describe the electron beam evolution we use the one-dimensional (1-d) Vlasov equation. Our perturbation result, valid for small values of the parameter *q* (length of the undulator *L* divided by the Rayleigh range *z_R*), can be extrapolated to values of *q* ≈ 4 ÷ 5.

Continued on page A6

M. R. Schroeder

Number Theory in Science and Communication

With Applications in Cryptography, Physics, Biology, Digital Information, and Computing

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This book is an introduction to number theory for non-mathematicians, with emphasis on applications in cryptography, physics, digital information processing and other fields. Results from number theory important to these fields are elucidated, including some that are not readily accessible in the literature. In contrast to prevailing mathematical texts with their emphasis on formal proofs, intuitive understanding of the salient facts of number theory is stressed. Probabilistic arguments are used throughout.

The reader can expect to derive from this book an appreciation of the importance of finite mathematics and number theory in active research fields and contemporary practical applications.



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Applied Physics A 35, No. 2 (1984)

Invited Paper

H. D. Riccius, K. J. Siemsen
Point-Contact Diodes 67

Contributed Papers

- R. A. A. Kubiak, E. H. C. Parker**
The Effects of Arsenic Source Contamination on Doped GaAs Grown by MBE 75
- E. Burzo, M. Valeanu**
Magnetic Properties of U(Fe_xAl_{1-x})₂ and U(Fe_yNi_{1-y})₂ Compounds 79
- L. Z. Mezey, J. Giber**
Numerical Values of the Surface Free Energies of Solid Chemical Elements 87
- R. Wedell**
Total Backscattering and Energy Reflection of Light Ions from Solids in the Single-Collision Approximation 91
- S. P. Speakman, R. A. Collins, G. Dearnaley**
Radiation Damage and Annealing Studies of Ion Bombarded Cobalt 99
- I. Ursu, L. Nanu, M. Dinescu, Al. Hening, I. N. Mihailescu, L. C. Nistor, V. S. Teodorescu, E. Szil, I. Hevesi, J. Kovacs, L. Nanai**
Vanadium Oxidation as a Result of cw CO₂ Laser Irradiation in Atmospheric Air 103
- Wang Yuming, Zhang Ziqung**
X-Ray Line Profile Analysis of Dislocations and Stacking Faults in Deformed Copper 109
- A. Annino, F. Grasso, F. Musumeci, A. Triglia**
Spectral Absorptivity of Rough Copper and Brass Surfaces 115
- D. Jaworska, J. Sielanko, E. Tarnowska**
Au Gettering by Ne and Ar Implantation in Silicon 119
- J. P. Bauerjee, S. P. Pati, S. K. Roy**
Computer Studies on the Space Charge Dependence of Avalanche Zone Width and Conversion Efficiency, of Single Drift p⁺nn⁺ and n⁺pp⁺ Indium Phosphide Impatts 125

Faraday Rotation in a Single-Mode Fiber with Controlled Birefringence

M. Grexa, G. Hermann, G. Lasnitschka, A. Scharmann (F. R. Germany)

Faraday rotation within a polarization non-conserving single-mode optical fiber is used for ac magnetic field measurement. For that purpose the intrinsic fiber birefringence on the path to and from the Faraday rotation section is controlled. As control devices externally applied stress birefringence and phase retarder plates were used. With respect to magnetic field measurements on high electric potentials all control devices are placed at fiber input and output only.

On the Multiple-Root Problem when Solving Directly the Nonlinear Coupled-Wave Equations for Two-Wave Mixing in a Reflection Geometry

Y. H. Ja (Australia)

A detailed analysis is given of the properties of the algebraic equations obtained when solving directly the nonlinear coupled-wave equations for degenerate two-wave mixing in a reflection geometry. An efficient method is developed for computing the appropriate root only amongst the multiple roots of these algebraic equations.

Effect of Resonant Laser Light Upon a Fast-Atom Charge-Exchange Source

E. W. Rothe, B. P. Mathur, G. P. Reck (USA)

The effect of resonant laser-light upon a charge-exchange source of eV-range sodium atoms is to decrease the Na kinetic energy by about 2 eV. The mechanism probably involves a reduction of the space charge in the low-energy ion precursors. The reduction is caused by electrons created in collisional ionization of laser-excited atoms. This is related to the well-known optogalvanic effect. A knowledge of the existence of this effect can be important for the design of experiments involving laser driven chemistry.

A Novel Method of DNA Transfection by Laser Microbeam Cell Surgery

M. Tsukakoshi, S. Kurata, Y. Nomiya, Y. Ikawa, T. Kasuya (Japan)

A new technique is presented to incorporate exogenous gene materials (DNA) into cells with a microbeam irradiation from an uv pulsed laser. A frequency-multiplied Nd:YAG laser, 355 nm wavelength, 5 ns pulse duration, punches a self-healing hole of submicrometer aperture in cell membrane under selected irradiation conditions. It takes a fraction of a second for the aperture to close, long enough to allow the foreign DNA, contained in the medium, to slip into the cell. The method offers a clear advantage over existing methods: increases the success rate of DNA transfection as well as the efficiency of cell modification by orders of magnitude.

Collimation of Atomic Beams by Resonant Laser Radiation Pressure

V. I. Balykin, V. S. Letokhov, V. G. Minogin, T. V. Zueva (USSR)

The application of the resonant light pressure created by an axially symmetrical light field for collimating atomic beams has been considered. As an example, consideration is given to the possibility of collimating an atomic beam by the light field produced by the reflection of a plane wave from the internal surface of a metal cone. It has been shown that the radiation pressure can reduce the atomic-beam transverse velocities to the value of the order of 100 cm/s which corresponds to effective temperature of about 10^{-3} K. A method for producing collimated beams of cold atoms based on simultaneous deceleration and collimation of atomic beams by resonant laser radiation pressure is proposed.

A New Blue-Green XeF(C→A) Excimer Laser Amplifier Concept

Y. Nachshon, F. K. Tittel (USA)

The feasibility of using the electrically excited XeF(C→A) excimer medium as an efficient wideband amplifier in the blue-green region of the spectrum has been investigated. Calculations show that for an intense blue-green optical flux input the amplification characteristics of XeF(C→A) improve, as a result of both bleaching of the pump induced absorbers and by additional production of XeF(C) level population. The removal of one of the major absorbing species, Xe** in the XeF(C→A) laser mixture by means of pulsed ruby laser probe beam has been demonstrated.

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Contents

Volume 11 · Number 10 · October 1984

- Progress of laser applications of China in recent 10 years
Lu Zhiguo
- Stability of laser traps
Cao Hongkui, Wang Yuzhu
- Study of the forward SRS phase conjugation
Feng Shiyu, Gao Sigan, Zheng Shunxuan, Liang Zhenbin, Ma Yingying
- Effect of discharge circuit inductance on laser output energy and discharge properties in an avalanche discharge XeCl* excimer laser
Zheng Chenen, Cao Hongming, Liu Bo, Wei Yunrong, Ding Aizheng, Lou Qihong
- Function analysis and parameter determination of resonator type fiber-gyroscopes
Sun Li, Deng Feifan
- Theoretical analysis and calculations of cylindrical step index optical fiber with a spherical lens excited with GaAs lasers
Zhang Zhipeng, Shi Shouyong
- Holographic recording characteristics of poly-N-vinylcarbazole photosensitive films
Yang Junhui, E Yun, Qin Jiabai, Ding Ruisong, Du Jinhuan
- Study of two-photon induced fluorescence of protein
Hui Lingkai, Li Qun, Zhang Zheng, Pan Chengming, Jiang Shouping, Lia Shaohui, Chen Ligun, Ruan Kangcheng, Huang Tianqin, Liu Songhao
- Power supply for acousto-optic modulation of frequency mixers
Pan Yinfei
- Investigation of operating conditions of glow discharge electron gun with aluminium cathode
Yu Zengqi, Lin Fengqi, Zhou Shiliang
- Simulation computation on dynamical processes of the high pressure 16 μm CO₂ laser
Zhuang Dounan, Zhao Donghuan
- Science Notes**
- Extracavity SHG of Ar⁺ lasers
Gu Yuangang, Zeng Yonglian, Chiu Mingxin
- Comparative luminescence and characters of two-photon absorption
Sun Maocong
- Automatic measurement and control system for laser level planes in construction
Ouyang Li
- Measurement of nonlinear index n₂ of InSb at 12 K
Cheng Ruihua, Luan Shaojin, Shen Hongwei, Wang Runwen, Tan Weihai
- Investigation of the characteristics of a single-frequency quasi-CW argon ion laser
Yang Yuanlong, Sun Diechi, Li Fuming
- Preliminary observation of curative effects of CO₂ laser irradiation on chronic prostatitis
Wu Tianlin et al.
- A simple calorimeter for pulsed CO₂ lasers
Fa Hejian et al.

Letters

- Economic profit gained by air-borne altimeter in the Y 10 airplane test flight measurement
Chu Chunlin
- Appraisal of single crystal films of (BiTm)₃(FeGa)₅O₁₂ and magneto-optic modulators
Liu Xianglin