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% ^{13}C enrichment was shown by Gauthier et al. [1] to be feasible and competitive with conventional technology. In this work, second-stage CO_2 laser enrichment of equimolar mixtures of $^{12}CHClF_2$ and $^{13}CHClF_2$ has been demonstrated yielding tetrafluoroethylene containing 95% or 99% ^{13}C. Forward enrichment by selective decomposition of the $^{13}CHClF_2$ fraction was very efficient, absorbing only 6 and 16 eV, respectively, per carbon atom produced at 95% and 99% ^{13}C 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.

Xe_2Cl Fluorescence and Absorption in Self-Sustained Discharge XeCl Lasers

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

Fluorescence at 490nm for the triatomic excimer Xe_2Cl^* 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 Xe_2Cl^* 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}. Xe_2Cl^* 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 $>1 MW\ cm^{-2}$. XeCl* and Xe_2Cl^* 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 $3s^2{}^1S_0$-$4s^1{}^1S_0$ transition. The conversion efficiency for the second-order harmonics has been measured to be $\sim 10^{-2}$% and for the fourth one $\sim 10^{-8}$%.

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 (l-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 $q \approx 4 \div 5$.

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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 hase 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($C \rightarrow A$) Excimer Laser Amplifier Concept

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

The feasibility of using the electrically excited XeF($C \rightarrow A$) 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($C \rightarrow A$) 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($C \rightarrow A$) laser mixture by means of pulsed ruby laser probe beam has been demonstrated.

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