FORTHCOMING PAPERS

A New Laser Concept for Isotopically Selective Analysis of Noble Gases

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A new laser approach for the isotopically selective analysis of noble gases is presended. This approach uses noble-gas atoms prepared in the $1s^5$ metastable state. Hyperfine levels in the $1s^5$ and $2p^9$ states form two-level systems in Ne, Ar, Kr, and Xe which can be excited by a commercially available single-frequency laser system. Absorption of photons from such a laser, and the resulting momentum transfer, can be used to selectively deflect the desired isotope from a supersonic atomic beam into a detection area. Light from the same laser can then be used to selectively count atoms of the desired isotope using the photon-burst technique. Thus, enrichment and selective detection are accomplished with a single laser in a single pass through the apparatus. The problem of analyzing for ^{85}Kr in a sample of noble gases extracted from the air is examined in detail. This is a stringent test of the selectivity of this approach because ^{85}Kr has the same nuclear spin, and thus similar hyperfine splittings, as naturally occurring ^{83}Kr. Calculations indicate that isotopic selectivity of the new approach is easily adequate to resolve ^{85}Kr in a 10^{10} excess of ^{83}Kr.

Laser Resonant Ionization of Plutonium

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Resonance ionization mass spectrometry (RIMS) has been tested for the isotope-selective determination of trace amounts of plutonium. An atomic beam is formed by evaporating plutonium atoms from a rhenium-filament heated to 1800 °C. The radiation of a pulsed dye laser excites the atoms in a two-photon process (λ = 595.2 nm) followed by photoionization of the excited atoms. Mass selectivity is obtained by use of a time-of-flight spectrometer. A resonant signal of ^{239}Pu was measured with 10^{13} atoms deposited on the filament.

Self-Field MPD Thruster with Atomic and Molecular Propellants

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This study is devoted to the design, the operational characteristics and optimization of a self-field magnetoplasmadynamic (MPD) arc in view of its applications as a thruster and as a plasma source for recombination lasers. Its principal characteristics, i.e. their terminal voltage V_{El} and the exhaust speed u_e as functions of the square of the discharge current I divided by the mass flow rate $\dot{m}$ are determined experimentally for atomic propellants. On the basis of measured diagrams V_{El} versus $(I^2/\dot{m})$ our discharge configuration is found to be well comparable to those applied by other laboratories. However, in order to further increase the specific impulse, these devices should make use of propellants of low molecular weight. Therefore, we also show that these thrusters can be operated in a quasi-steady mode for atomic as well as for molecular propellants, e.g. H_2, N_2, O_2. Existing theories and interpretations of observations on atomic propellants are reviewed and, if possible, extended to explain the experimental results obtained with molecular propellants. In the framework of these extended theories the high-power limit of a stable operation is well understood.

Multiphoton Absorption and Luminescence of Osmium Tetroxide

D. K. Evans, H. M. Adams (Canada)

Both the multiphoton absorption and the luminescence brightness of osmium tetroxide induced by absorption of temporally smooth CO_2 10*P*(20) laser pulses of 10 and 40 ns FWHM have been measured for pressures in the range 6.7 to 200 Pa. A dependence of these phenomena on laser pulse length is observed. Comparison of the luminescence brightness to the average excitation shows that the distribution of the multiphoton excitation depends on the laser pulse intensity for the two pulse lengths studied.

CARS Study of SiH_4-NH_3 Reaction Process in Glow Discharge Plasma

K. Kajiyama, K. Saito, K. Usuda, S. S. Kano, S. Maeda (Japan)

We have investigated the glow discharge plasma of SiH_4-NH_3 mixture by CARS. The decomposition rate of NH_3 is linearly dependent on SiH_4 partial pressure but that of SiH_4 is not affected by the mixing ratio.

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