High-Power CO Laser with RF discharge for Isotope Separation Employing Condensation Repression

Igor Ya. Baranov[1]

Baltic State Technical University, 1st Krasnoarmeyskaya st. 1, 190005 St. Petersburg, Russia

The way of transfer from CO small-scale device to CO laser for isotope separation is proposed. The calculation model scaling of CO laser with RF discharge in supersonic flow with cooling by its expansion in the nozzle is developed.

The laser excitation might separate more economically then traditionally techniques using mass-action diffusion, ultracentrifuges end electromagnetic separation.

In the CRISLA (Condensation Repression Isotope Separation by Laser Activation) intracavity illumination at 5,3 μm from CW CO laser (by using isotopic CO) is used to excite $235UF_6$ in a supersonic super-cools free jets and suppression of dimmer formation [1]. The low $235UF_6$ absorption cross-section for 5,3 μm photons requires very high laser photon fluxes and must possess high-power CO laser operating on $3\nu_3$ rovibrational absorption of UF_6.

The high power and high efficiency were received on the experimental CO lasers. They operate in a quasi-cw with cooled CO mixture by its expansion in the nozzles. The electron beam stabilizes the discharge in the supersonic flow and increases its efficiency.

The way of transfer to industrial high-power CO lasers is proposed through the use of a low-current radio-frequency (RF) electric discharge in a supersonic gas flow without an electron gun [2]. The laser generation was received on the small-scale device with RF discharge in a supersonic flow [3].

The low-current RF discharge in the supersonic stream is stable and homogeneous. The model is developed for simulating the low-current moderate-pressure RF discharge [4].

The calculation model scaling of CO laser with RF discharge in supersonic flow is developed. The model can be used to determine the energy of CO laser with a low-current RF discharge and optimize its construction**.** The model consists of the block of calculation of RF discharge parameters, the block of vibrational kinetic equations and the block of the gasdynamic equations describing a supersonic flow in discharge zone.

The proposed CO laser has a closed working cycle and a RF capacitive discharge to excite a supersonic gas flow cooled to cryogenic temperatures due to expansion in nozzle. The RF discharge in supersonic flow allows working with high pressure before the nozzle and medium - pressure after diffuser. Therefore a body of closed contour isn’t need. There are only pipelines and a head of laser may be installed in any place. The laser can work without a fiber-optic delivery. It is possible to use the serial compressor.

Technical decision is considered on the basis of proposed CO laser for isotope separation employing condensation repression. The estimated cost of proposed laser is several hundred thousand USD. So low cost comes out from the absence in the closed working cycle: a body of closed contour, a special pumping system, cryogenic refrigerators, sectionalized of electrodes, active ballast resistances, an electron gun, a fiber-optic delivery. The available serial elements in the laser at early stages of design make possible to reduce substantially expenditures on it performance.

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[1] E-mail: prof.i.baranov@mail.ru