

The Experimental Research of the RF Discharge in O₂ and its Mixtures

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A 45 MHz RF discharge was obtained in pure O₂ and its mixtures, the discharge cross-section is 5×5 mm² and length is 400 mm. To study the influences of discharge parameters on electron energy, a Langmuir probe system was set up. And the intensity of oxygen atom at 777.19 nm was used to investigate the decomposition of the O₂ in the RF discharge.

Oxygen Iodine Lasers are very attractive because of its high efficiency, short wavelength and minimum loss for optical fiber transmission. Conventional singlet-delta oxygen generation is a typical gas-liquid reaction system. However the moisture from it could quench the excited atomic iodine, and the reactants of the singlet-delta oxygen are deep-etching and poisonous, which could cause environment pollution. Therefore, recently researches are focusing on electric discharge to produce singlet delta oxygen in pure oxygen and its mixtures. Electric discharge using DC, RF, microwave discharge .etc, have been studied in the singlet delta oxygen generators. RF is a good choice because of its high stability and uniformity, and has been successfully used in various gas lasers. In this paper the experimental results on the characteristics of oxygen plasma in RF discharge are presented.

Currently the improvement on yield of singlet delta oxygen is still the research emphasis. Theoretical studies have demonstrated that the high electron energy is the main restricted factor on the yield increase, and the over high electron energy can also lead the decomposition of oxygen molecule, which is harmful to the production of iodine laser. Therefore, it is necessary to investigate the electron energy in the discharge gases and the O₂'s decomposition under various discharge conditions.

An experimental RF discharge device was established with the cross-section of 5×5 mm² and length of 400 mm. The radio frequency as excitation source was 45 MHz, and the power was modulated by the pulse width. The Langmuir probe system was used in measurements of electron average energy in pure oxygen and its mixtures. The effects of pressure, RF pulse width and gas compositions on the electron temperature have been investigated. The results show that electron temperature goes down with the increasing pressure, narrowing pulse width and the addition of He and Ar.

The spectrums in pure oxygen and its mixture with He, Ar and Xe have been measured, and according to the line intensity of oxygen atom at 777.19 nm, the mixture influences on O₂'s decomposition have been investigated. In O₂-Ar and O₂-He the intensities of 777.19 nm are close to the one in pure oxygen, while in O₂-Xe it is much weaker, it shows that Xe is more effective in inhibition of O₂'s decomposition.

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