The 15th International Conference

AMPL-2021

PULSED LASERS AND LASER APPLICATIONS

September 12–17, 2021
Tomsk, Russia

ABSTRACTS

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Atmospheric and Oceanic Optics Journal, Tomsk, Russia
Photonics Journal, Moscow, Russia

Scientific & Technical Translations
STT
PUBLISHING
Tomsk, 2021

THE 15th INTERNATIONAL CONFERENCE
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Session E
NON-COHERENT UV AND VUV RADIATIO SOURCES

E-1

PECULIARITIES OF APOKAMP FORMATION FROM ELECTRODE WITH CERAMIC COATING

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This work continues the cycle of our studies of a new discharge phenomenon – the expansion of the glowing structure at a bend in the channel of a pulsed high voltage discharge in air. In [1], it was called the apokamp discharge, and the structure was called the apokamp. The apokamp consists of a bright offshoot and a long plume. We have shown experimentally and theoretically that the plume is a positive streamer starting from the bend of the plasma channel with a characteristic speed of tens and hundreds of km/s, depending on the applied voltage, pressure and type of gas. The bending of the canal provides a local amplification of the field, which sets the starting orientation of the expanding streamer canal [2, 3].

In this work, the apokamp is formed from an electrode with a flat ceramic coating. It was found that, in comparison with the two electrode configuration, under the same conditions of discharge initiation at an air pressure of 120 Torr, the average velocity of the apokamp propagation up to 520 km/s was recorded. Analysis of the emission spectra of the apokamp revealed an increase in the intensity of the nitrogen ion lines with a wavelength of 391.4 nm in the streamer zone. With a decrease in pressure to 30 Torr, the propagation rate of the apokamp decreases by a factor of ~ 4.

The work was carried out within the framework of the State Assignment of the IHCE SB RAS, Project No. FWRM-2021-0014 and with the financial support of the Russian Foundation for Basic Research within the framework of the scientific Project No. 19-32-90023

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E-2

NARROW BAND UV LAMP BASED ON IODINE VAPOR

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To date, various sources of spontaneous emission in the UV and VUV spectral regions have been developed. One of the most efficient sources are high pressure barrier discharge excilamps, which use radiation from excimer (Xe^{2*}, Kr^{2*}, Ar^{2*}) or exciplex ($KrCl^*$, $XeCl^*$, $XeBr^*$, $KrBr^*$) molecules. Among the low pressure radiation sources based on atomic transitions, the most effective are low pressure mercury lamps with resonance lines of 185 and 253 nm with a specific radiation power of up to ~ 10 mW/cm^2. Less efficient are deuterium lamps emitting at the 121.5 nm atomic line and continuous radiation with a maximum near 161 nm. Radiation in the VUV spectral region with a specific power up to ~ 4–7 mW/cm^2 can also be obtained at the resonance lines of argon (107 nm), krypton (124 nm), and xenon (147 nm), excited by a low pressure discharge. The search for new media that expand the spectral range and energy parameters of radiation sources in the UV and VUV regions of the spectrum is important due to the presence of a number of practical applications of radiation sources in the UV and VUV regions of the spectrum, in particular, the possibility of their use for inactivation of viruses, including COVID 19.

This paper presents the results of experimental studies of the amplitude time, energy, and spectral characteristics of lamp radiation in the UV and VUV spectral regions based on iodine vapor excited by a low pressure capacitive discharge. When performing the work, a comparison was made of the radiative characteristics of iodine vapors and their mixtures with inert gases. The light source under study based on iodine vapor can compensate for the lack of spontaneous emission sources in the spectral range of 175–210 nm.

The studies were performed in the framework of the State Task for IHCE SB RAS, Project No. FWRM-2021-0014.

E-3

FEATURES OF THE XENON EXCIMER VUV SPECTRA FORMATION

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In the work the dependence of the xenon dimers second continuum (transition $^{3,1}\Sigma^+_u \rightarrow {}^1\Sigma^+_g$, emission maximum ~ 172 nm) spectrum shape on the gas temperature was investigated.

Xe_2 dimers second continuum spectrum lies in the short wavelength ultraviolet region (vacuum ultraviolet (VUV) one) and has a high photochemical potential. Xenon VUV lamps are used in the technological processes of dry cleaning and activation of surfaces during coating [1], decomposition of pollutants [2, 3], when applying metal and dielectric layers [4]. The photochemical application of xenon excimer lamps determines the importance of studying the transformation of the spectrum into the short wavelength part of the spectrum for the implementation of photochemical reactions with a higher energy threshold.

Theoretical [5] and experimental [6] studies show that the emission spectra of the second continuum of rare gas dimers undergo broadening with increasing gas temperature, with the maximum of the emission spectrum shifting towards shorter wavelengths. According to [5], the width of the spectrum at half maximum of the emission of xenon dimers with a change in the gas temperature from T = 300 K to T = 600 K increased from 13 to 16.5 nm, and the maximum of the spectrum shifted by $\Delta\lambda$ = 1.5 nm.

In our work, we recorded the emission spectra of the second continuum of xenon dimers excited in a barrier discharge at different frequencies of the applied voltage. Since the electric power supplied to the discharge increases with an increase in the frequency of voltage pulses, this leads to an increase in the gas temperature and makes it possible to study the change in the spectra as a function of temperature. According to the experimental results, the spectral widths at half maximum were 15 nm (f = 1 kHz), 19 nm (f = 20 kHz), and 20.5 nm (f = 33 kHz). The broadening of the spectra is more pronounced in the short wavelength region, which leads to a shift in the maximum of the continuum from 173.2 to 172.5 nm. This behavior of the spectra is consistent with calculations [5].

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